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THE USE OF CATION EXCHANGE RESINS IN THE TREATMENT OF CONGESTIVE HEART FAILURE

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The pathogenesis of the symptoms and signs of congestive heart failure is intimately related to a decrease in the rate of renal sodium excretion and, to a considerable extent, the rational therapy of heart failure is directed at resolving the resultant discrepancy between the intake and the output of the sodium cation (1). In recent years this has been achieved by sharply limiting the sodium content of the patient's diet or by employing agents such as mercurial diuretics to promote an increase in the urinary excretion of salt and water. Although such therapy is successful in the vast majority of patients, in many cases a regimen of this kind meets with failure. Some individuals are unwilling or unable to follow a diet in which the sodium content is rigidly limited, and others, intent on restricting their salt intake, may do so at the expense of an adequate intake of protein or some other essential food element. Sodium-free salt substitutes have been introduced, but certain of these have proved to be toxic (2), whereas others have lacked palatability. As a result of these factors, many patients become lax in limiting their salt intake and require frequently repeated injections of mercurial diuretics. This procedure generally entails some inconvenience to the patient and often fails to maintain him in an optimum state of cardiac function. The introduction of the cation exchange resins into the therapeutic armamentarium of the physician has provided a tool by which this dilemma can be solved, at least in part.

Synthetic resins have been known to industry for many years, in the form of bakelite and other similar substances. These were originally considered to be relatively inert chemically; however, it was found that the phenolic hydroxyl groups of the bakelite type of resins were capable of ionizing and entering into exchange reactions with substances in their surrounding media (3). Besides bakelite, many other resinous substances have been synthesized and their properties as ion exchangers studied. Compounds of this kind have found numerous uses in the home as well as in industry and in the analytical laboratory. Perhaps

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the most widely known of these applications is in the purification and softening of water.

The physicians of ancient Greece unwittingly utilized the principle of ion exchange when they prescribed "Terra Sigillata" as an antidote for certain poisons (4). The therapeutic application of synthetic exchange resins, based upon their chemical behavior, was first instituted by Segal and his associates in 1945 when they studied a polyamine-formaldehyde resin as an agent to reduce gastric acidity (5). Following these initial observations an anion exchange resin was introduced for the clinical management of peptic ulcer (6). In 1946 Dock suggested the use of a cation exchange resin to take up sodium from the gastrointestinal tract (7). Today several cation exchange resins are available to the physician, providing potential agents for the management of congestive heart failure. A knowledge of their basic chemical nature and pharmacologic actions is, therefore, of importnace.

Chemical nature of exchange resins

Chemically, the synthetic cation exchange resins are polymers of aromatic hydrocarbons, such as phenolsulfonic, carboxylic and/or benzoic acid. These are linked and cross linked by short and virtually indestructible hydrocarbon chains (8, 9, 10). The chemical groups available for the cation exchange process, such as the sulfonic or carboxylic radicals, are attached to the benzene rings. When placed in aqueous solutions, the resin particles take up water and increase very markedly in bulk. In this state they may be regarded as gels and, because of the ionization of the acid radicals, the individual resin particles are capable of exerting osmotic activity (11, 12). Under these circumstances the distribution of electrolytes between a given resin particle and its surrounding medium depends upon equilibria which are similar to the Gibbs-Donnan effect.

In order that a resinous substance be capable of exchanging one cation attached to a given resin particle for another cation in its environment, it is apparent that the resins must have different degrees of affinity for different cations. It has been demonstrated that the affinity of a resin for a given cation is dependent upon such factors as the valence, the atomic weight and the radius of the unhydrated ion. For example, calcium with an atomic weight of 40 and a valence of 2, will enter into exchange with a resin particle, in preference to sodium with an atomic weight of 23 and a valence of 1. Such relationships, however, hold only in dilute solutions and the order of preference is radically changed by increasing the concentration of one of the competing cations. For example, in a solution containing a predominance of sodium ions, sodium is preferentially taken up by the resin particles. In addition, other factors, such as the pH of the medium the degree of swelling of the resin particles and the nature of the solvent, will alter this relationship. It is obvious from these considerations that the cation exchange process can not be explained by simple phenomena of surface absorption.

Resins in which the cation available for the exchange process is hydrogen, are commonly referred to as hydrogen-cycle resins. If the available hydrogen ions

are replaced by some other cation such as sodium, potassium, calcium, lithium or ammonium, the resins are then referred to as salts of the resinous substance.

Effects of resin administration

When a cation exchange resin alone is administered to a patient in the form of its hydrogen cycle, the available hydrogen ions of the resin undergo ion exchange with the cations in the fluid of the gastrointestinal contents. Sodium occupies a prominent position in the electrolyte pattern of the intestinal fluids beyond the stomach and therefore enters readily into cation exchange with the resin particles, thus resulting in an increase in fecal sodium content (13, 14). The anions originally associated with the ingested sodium are then free to be absorbed from the lumen of the gastrointestinal tract and, because chloride represents the predominant anion in this environment, the serum chloride concentration tends to increase. This increase in the serum chloride concentration is normally compensated by a decrease in the serum bicarbonate and by an increase in urinary chloride excretion, thus resulting in a compensated chloride acidosis. In the presence of normal renal function the chloride acidosis resulting from resin administration resembles that accompanying the ingestion of ammonium chloride, and a transitory increase in urinary sodium content may be observed (13). After resin therapy has been in effect for several days the urinary sodium and potassium excretion are generally decreased in proportion to the fecal content of these cations, and the titratable acidity of the urine continues to be increased. The acidosis resulting from such resin administration may become severe and the fecal loss of potassium may be sufficiently great to cause a clinically significant deficiency of this cation (7, 13, 15, 16).

Such manifestations are obviously undesirable side-effects of resin administration. In order to avoid these untoward reactions, certain modifications in resin make-up have been evolved. If an anion exchange resin is incorporated together with the cation exchanger, then the amount of anion (*e.g.*, chloride) available for absorption from the gastrointestinal lumen into the interstitial spaces is limited and the tendency to develop acidosis is diminished. In addition, if a portion of the cation exchange resin is administered as its potassium salt, the tendency to cause depletion of body potassium is decreased.

With such a pattern in mind, one of the ion exchange resins currently available[1] contains 12 per cent anion exchange resin, 29 per cent potassium salt of carboxylic acid resin, and 59 per cent carboxylic acid resin in the hydrogen cycle. Another preparation[2] which is currently available consists of a mixture of 75 per cent ammonium salt of sulfonic acid and 25 per cent potassium resin sulfonate. Resins of the carboxylic acid type are most efficient as ion exchangers at high pH levels. At pH values of 3.5 and lower, however, they tend to revert entirely to the hydrogen cycle. The incorporation of an anion exchanger has been shown to increase the efficiency of the carboxylic acid resin with regard to sodium

[1] Carbo Resin—Eli Lilly & Company.
[2] Katonium—Winthrop Stearns.

removal (17). Resins of the sulfonic acid type have been shown to be active over a wide pH range.

Several studies have been carried out with regard to the efficiency of the exchange resins in removing sodium which has been ingested (14, 17). When the dietary intake of sodium is only moderately restricted and the patient receives a diet permitting the use of ordinary bread, milk and butter, but no salt added in cooking, resulting in a dietary intake of approximately 1,035 mg. of sodium, the mixed carboxylic acid and anion resins will remove approximately 1 milliequivalent or 23 milligrams of the ingested sodium per gram of resin. Under these circumstances 45 Gm. of resin would, theoretically, remove all of the sodium (45 mEq.) ingested in a 24-hour period. In contrast, if dietary sodium is more rigidly restricted and the intake is limited, then the efficiency of the administered exchange resin is greatly reduced. Under these circumstances 1 Gm. of resin will take up approximately 0.3 mEq. or 7 mg. of sodium. From data of this kind it has been adduced that the ingestion of resin does not promote the fecal loss of endogenous sodium and that the effects of resin administration are confined to the sodium ingested in the food. In addition, it has been demonstrated that the efficiency of the exchange resins is further reduced by the simultaneous administration of desoxycorticosterone acetate (18). Thus the influence of the sodium-retaining adrenal cortical steroids, which have been identified with the genesis of congestive heart failure, may serve as an additional factor in limiting the efficiency of the exchange resins in sodium removal.

Since the maximum dose of resin which the average patient can tolerate safely and comfortably is 60 grams per twenty-four hours, it is apparent that the usual American diet containing 100 to 300 mEq. of sodium per twenty-four hours would permit a significant excess of sodium beyond the exchange capacity of the resin, and this excess would be absorbed into the body. It is obvious, therefore, that the exchange resins do not represent a cure-all. One can not generally prescribe them to a patient with congestive failure and tell him to eat whatever he likes. An additional factor in this regard is that, when the fecal sodium excretion is increased by resin therapy, urinary sodium excretion is proportionately decreased. In spite of these limitations, it is often possible to alter the balance of sodium significantly enough to prevent its accumulation.

Resin administration not only produces changes in the excretion of sodium, chloride and potassium, but other biochemical and physical changes as well. The ingested resin takes up water and, therefore, the bulk of the stool may increase as much as eight-fold. As a result, diarrhea develops in some patients, whereas others may complain of constipation. Most patients note a sensation of fullness which tends to diminish the appetite. In addition to the removal of sodium and potassium from the food ingested, the cation exchange resins are capable of removing calcium, magnesium, and iron. Deficiencies of magnesium and iron have not been observed as a consequence of resin therapy, but they represent theoretical possibilities. Significant lowering of the serum calcium concentration has been observed (16, 20) but tetany has not occurred because of the accompanying acidosis. No evidence of demineralization of bone has been reported (17). No adverse effects on protein or vitamin metabolism have been observed.

Indications

The use of cation exchange resins is indicated in the presence of any condition in which the restriction of dietary sodium is therapeutically desirable. Among patients with congestive heart failure, resins are particularly indicated in individuals who have recurrent edema and/or ascites and in those who are unable to follow rigid salt restriction because of dietary habits and/or social factors. The exchange resins are of particular value in patients who require frequent mercurial injections, in those who are sensitive to the mercurial diuretics, and occasionally in those who are refractory to these diuretic substances.

Contraindications

The cation exchange resins are contraindicated in patients with far advanced renal disease, because of the danger of the development of irreversible chloride acidosis. In the presence of advanced liver disease resins containing ammonium ion should be avoided (19). The cation exchange resins are contraindicated in persons with peptic ulcer, because these substances may potentially increase gastric acidity. In patients with regional enteritis or with ulcerative colitis they should be avoided because of possible side effects following their administration.

Administration

Resin administration is preferably instituted in the hospital, but can be carried out on an outpatient status if suitable facilities are available. A preliminary determination of serum electrolyte concentrations (including chloride, bicarbonate, sodium, potassium and pH) should be obtained, as well as of the blood urea nitrogen. The most significant of these, when laboratory facilities are limited, are the serum chloride, bicarbonate, and blood urea nitrogen determinations. Following the demonstration of adequate renal function and a normal serum electrolyte distribution, the dietary sodium intake should be adjusted to a level of from 3 to 4 grams of sodium chloride daily. The resin can then be administered in doses of from 10 to 20 grams three times daily. This dosage may be given in water, if the resin is flavored, or in various other vehicles such as milk or carbonated beverages. Several recipes have been prepared by one pharmaceutical concern[3], so that the resin dosage can be taken in cookies, candy or cake. Following the initiation of resin therapy, the patient should be observed closely during the first several weeks and a determination of serum electrolytes should be repeated within one week. A rise in serum chloride concentration with a decrease in the serum bicarbonate level during the first week will occur, but this does not necessitate stopping the resin therapy. If such changes progress, the dose of resin may be decreased or the salt intake liberalized. Not infrequently, abnormalities of electrolyte distribution, as well as gastrointestinal disturbances, tend to develop more rapidly if a patient has severe congestive failure. Under these circumstances, if the patient exhibits signs and symptoms of severe heart failure and does not tolerate resin therapy because of gastrointestinal or electrolyte disturbances, it is advisable to stop resin administration temporarily. The

[3] Eli Lilly & Company.

heart failure can then be treated by other means, and resin therapy reinstituted in the form of maintenance management.

Precautions

The cation exchange resins exert a potent effect on electrolyte exchanges and, as a result, it is important for the physician to be alerted to the abnormalities of electrolyte balance which may occur. The development of chloride acidosis has already been mentioned. This may become compensated and the patient may then go along with an elevated serum chloride level, a reduced CO_2 and a relatively normal pH. If such a chloride acidosis is progressive (and this usually occurs in the presence of inadequate renal function), the resin dosage may be decreased or temporarily discontinued, the salt intake may be increased, or resin therapy may have to be abandoned. In some patients edema may tend to reaccumulate despite the use of the exchange resins, and in these individuals the periodic administration of mercurial diuretics may be required. As previously indicated, the cation exchange resins produce a change in the serum electrolyte pattern which is similar to that observed with ammonium chloride administration. In a parallel manner the cation exchange resins tend to potentiate the effects of mercurial diuretics (13, 17). This latter factor introduces another problem in resin therapy, in that the use of exchange resins together with dietary sodium restriction and mercurial diuretics may produce the syndrome of sodium depletion, characterized by weakness, fatigability, excessive thirst, hypotension, a rising level of blood urea nitrogen, coma, and even death. In its early stages this can be corrected by stopping the resin and the mercurial diuretics; however, in its advanced forms it is commonly progressive and death supervenes.

It is of utmost importance to recognize that the cation exchange resins available today do not represent a definitive solution to the problem of therapy in congestive heart failure. In their present form they may be regarded as important therapeutic adjuncts which permit the use of a somewhat more liberal intake of dietary sodium and thereby a more adequate intake of protein and other food elements. The current use of resins does not generally eliminate the need for a moderate restriction of dietary sodium. Moreover, their administration is accompanied by gastrointestinal complications and the potential hazard of abnormalities in mineral metabolism. Some individuals gain a feeling of overconfidence from the use of resins and are inclined to over-exert themselves during periods when they are symptom-free, with a resultant deterioration in their overall status. In this regard, the use of exchange resins does not provide a substitute for restriction of activity.

SUMMARY

The cation exchange resins provide a new and important tool in the management of heart failure. These substances can potentially tend toward more palatability in the diet and thereby toward more adequate nutrition, but they do not represent a substitute for restriction of activity or of moderate dietary salt limitation. Their use is limited by the patient's gastrointestinal tolerance

and by the potential hazards of electrolyte imbalance. They are generally contraindicated in the presence of advanced renal disease. In any case, they should be used only under circumstances in which the clinical course of the patient and the levels of serum electrolytes and blood urea nitrogen can be followed closely—at least during the initial period of resin therapy.

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FRACTURES OF THE ANKLE JOINT IN ELDERLY PEOPLE

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Fractures of the ankle joint are rather frequent in elderly people. The treatment of such injuries in this group is fundamentally the same as in younger adults. There are certain factors, however, which require specific attention, such as prolonged gravitational edema, retarded return of normal function, circulatory variations, and cutaneous changes. These conditions require treatment and consideration in addition to the reduction of the fracture.

The importance of closed reduction cannot be overemphasized because it is the preferred method at all ages, but more so in the aged. The type of fracture necessitating open reduction may be complicated by vascular changes in the skin areas before or after surgery and can create a problem in addition to the fracture difficulty. Open reduction must be reserved for the difficult fractures not manageable by casting methods.

Advanced age in the patient does not excuse poor reductions or lack of posttraumatic attention, and the fact that many perhaps have a limited life span does not allow one to compromise the situation. Mobility in the aged is very important to their well being, and locomotion should be encouraged.

ANATOMIC CONSIDERATIONS

The osseous structures of the ankle joint are the distal portions of the tibia and fibula and their articulations with the body of the talus. The ligamentous structures which secure the joint relationships are the deltoid ligament on the medial side (Fig. 1), and the calcaneofibular and the talofibular ligaments on the lateral side (Fig. 2). The anterior and posterior ligaments of the ankle joint are not very strong; the anterior one is the less adequate. The fibula and tibia are held in position by the interosseous ligament and the multiple malleolar ligaments. The joint is a very strong structure with ample latitude of motion, especially in flexion and extension. The talus fits the intermalleolar mortise quite efficiently (Fig. 3), and this stability (Fig. 4) offers the greatest resistance to abnormal forces of inversion, eversion, and forced rotation.

The excessive forces which produce fractures of the ankle joint by indirect violence are inversion or adduction, eversion or abduction, external rotation of the foot, and forced plantar and dorsiflexion. Direct violence resulting from a fall may cause transverse, comminuted, or various types of fractures of the ankle, depending on the severity of the injury (Fig. 5). Direct violence may also be applied by objects moving in opposite directions to the fixed foot or leg, or when the foot is forced in an abnormal direction at the ankle joint level.

The inversion or adduction type of fracture results when the foot is inverted beyond physiologic limits; the lateral ligaments are torn (Fig. 6), usually with a

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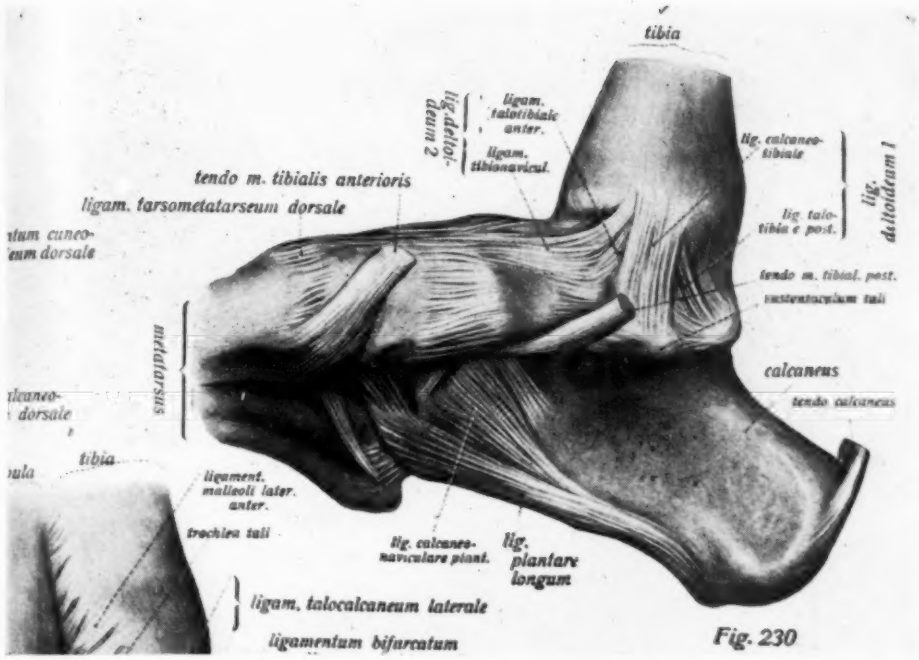


FIG. 1. Medial ligaments of the ankle joint. (Reproduced with permission from Sobotta, J.: Atlas of Human Anatomy. New York, G. E. Stechert & Co., 1927; Hafner Publishing Co., 1953.)

FIG. 2. Tibiofibular ligaments of the ankle joint. (Reproduced with permission from Sobotta, J.: Atlas of Human Anatomy. New York, G. E. Stechert & Co., 1927; Hafner Publishing Co., 1953.)

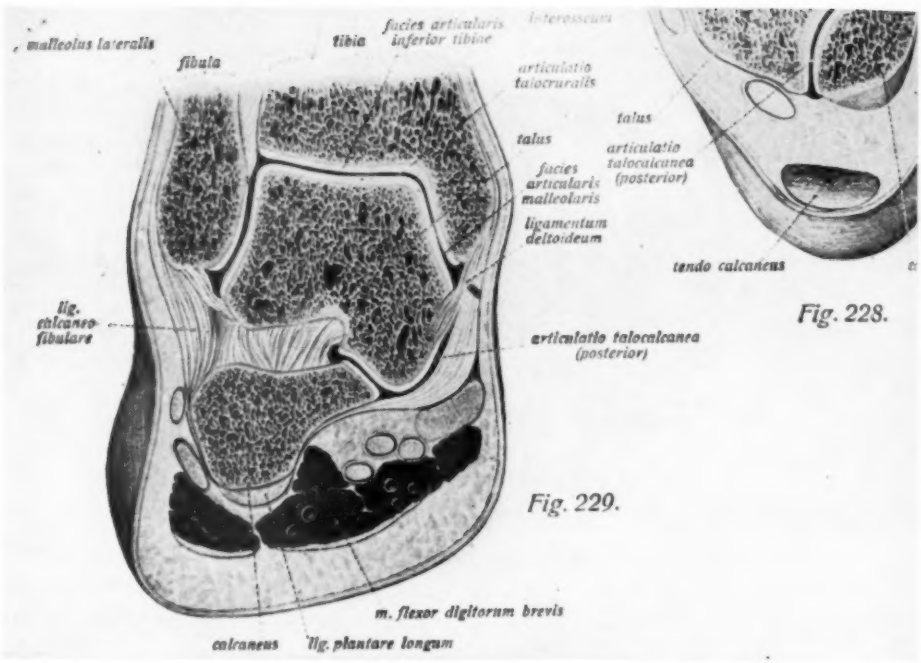


Fig. 228.

Fig. 229.

FIG. 3. Ankle mortise. Note sulci on both sides of talus which are important in compound fractures. (Reproduced with permission from Sobotta, J.: Atlas of Human Anatomy. New York, G. E. Stechert & Co., 1927; Hafner Publishing Co., 1953).

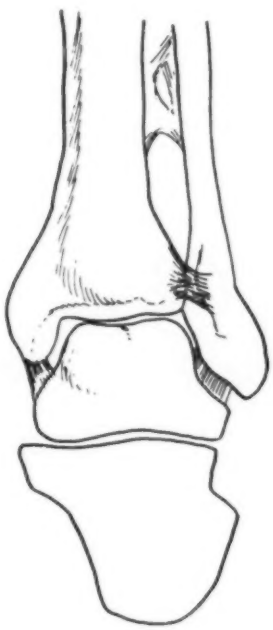


FIG. 4

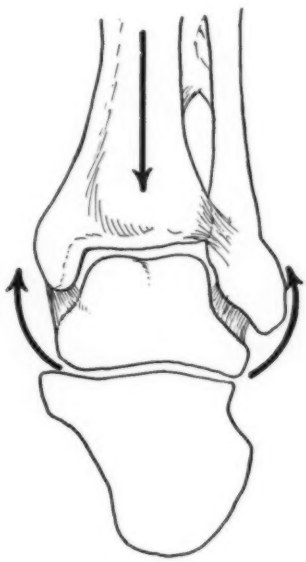


FIG. 5

FIG. 4. Diagram of three basic supportive ligaments of ankle joint
FIG. 5. Ankle joint. Direction of inversion, eversion, and direct forces

fragment of fibula, and as the inversion progresses, the medial malleolus is fractured at its base. Thus, the entire foot displaces medially, due to loss of ligamentous support and intermalleolar stability.

FIG. 6. Tip of lateral malleolus may be pulled loose; inversion type

FIG. 7. Tip of medial malleolus may be pulled loose. Eversion type

The abduction type of fracture is the result of abnormal eversion, with the force pulling on the internal or the deltoid ligament. The ligament may rupture, but usually tears off the internal malleolus in varying degrees (Fig. 7). After the loss of support of the deltoid ligament, the force continues in abduction and may affect the fibula in two ways. If the interosseous and tibiofibular liga-

ments remain intact, the external malleolus is fractured distally to them (Fig. 8). Should the interosseous and tibiofibular ligaments tear, the fibula usually fractures at a point proximal to the ligamentous structures (Fig. 9-A). Thus, the ankle mortise is widened, due to the diastasis of the tibia (Fig. 9-B) and fibula with lateral rotation and posterior displacement (subluxation) of the foot at the ankle joint.

Internal rotation of the leg with the foot fixed, or the leg fixed and the foot externally rotated, results in twisting of the talus in the mortise (Fig. 10-A, B and C). The body of the talus impinges the lateral malleolus, which is firmly held by the lateral ligaments; thus the distal end of the fibula rotates with the foot, resulting in a torsion fracture extending from posterior to anterior portions of the fibula; this is best seen in the lateral roentgenogram. Should the rotation

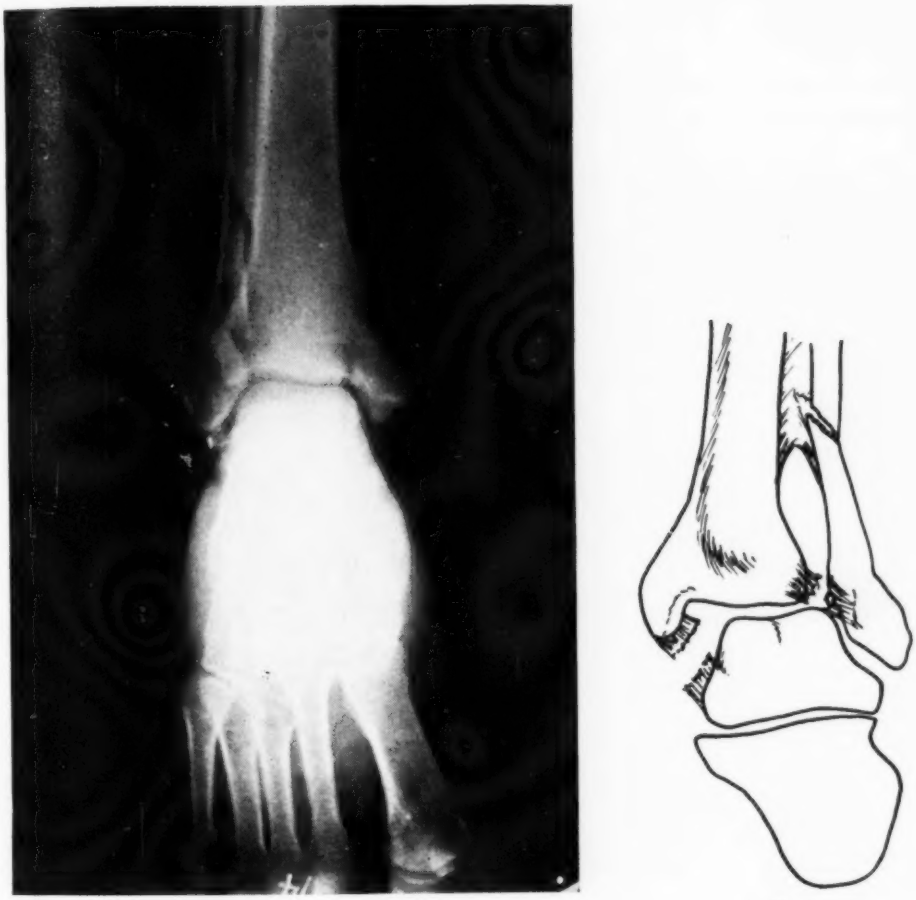
FIG. 8. Lateral malleolus fracture at a point distal to tibiofibular ligaments

continue, the medial malleolus (Fig. 11) would be fractured. The foot may displace posteriorly in partial luxation.

Forced plantar flexion causes the talus to press on the posterior portion of the tibial articulations, and fractures the overhanging margin in varying degrees with proximal displacement (Figs. 12 and 13-A and B). This condition may accompany fractures involving external foot rotation or eversion.

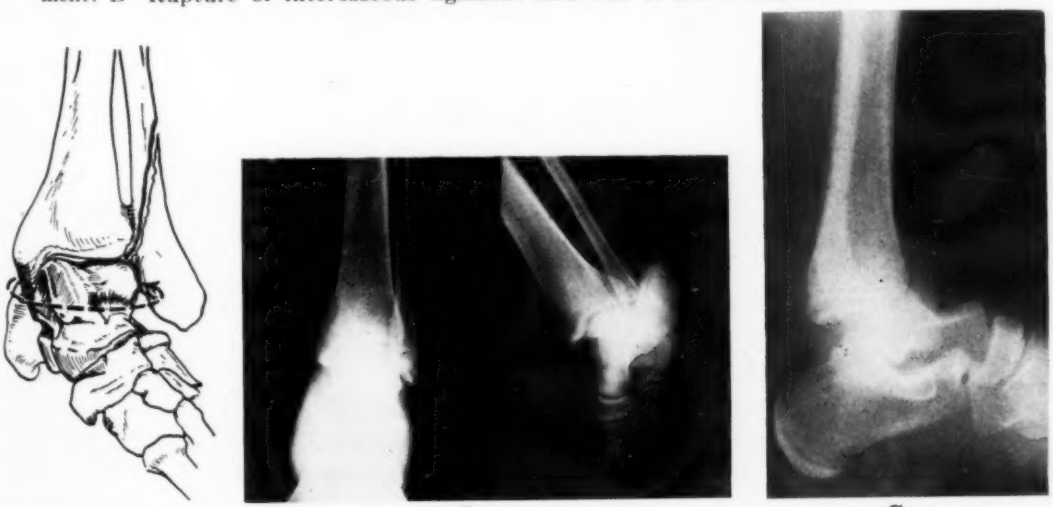
Forced dorsiflexion fractures the anterior margin of the tibial articular surface (Fig. 14).

Fractures due to violence of direct pressure may split the tibia (Fig. 15) and fracture the fibula (Fig. 16). There is no limit to the possible pattern of the fracture, ranging from a simple longitudinal undisplaced fracture to Y, T, or extensive comminution. The articular surface is usually damaged and later the occurrence of traumatic arthritis is frequent.



A B

FIG. 9. A—Fracture of medial and lateral malleoli and fibula above interosseous ligament. B—Rupture of interosseous ligament and loss of ankle mortise.



A B C

FIG. 10. A—Rotation type of fracture; fibula splits distal to interosseous ligament. B—Rotation fracture of ankle joint before and after reduction. C—Rotation fracture of ankle joint with unusual anterior displacement of foot.

The various etiologic factors result in fractures which can be classified according to the osseous structures damaged. They are:

1. Fracture of the medial malleolus.
2. Fracture of the lateral malleolus.
3. Bimalleolar fractures.
4. Fracture of the posterior tibial margin.
5. Fracture of the anterior tibial margin.
6. Bimalleolar fracture with rupture of the interosseous tibiofibular ligament.
7. Multiple fractures, such as combinations of above, and various degrees of comminution.

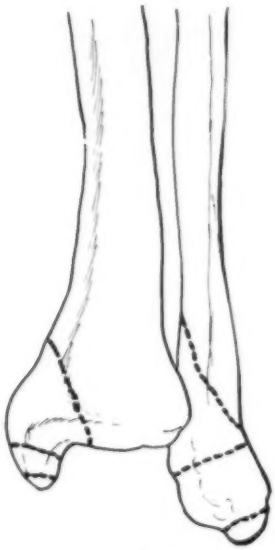


FIG. 11

FIG. 12

FIG. 11. Possible combination of malleolar fractures

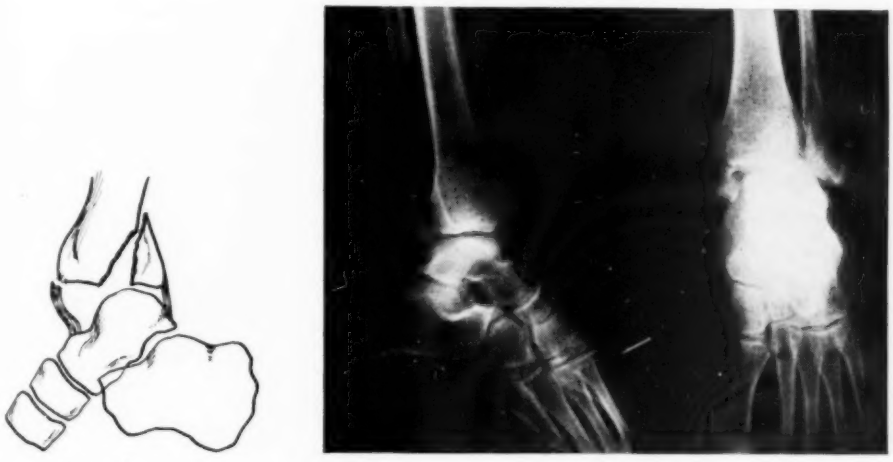
FIG. 12. Fracture of posterior lip of tibia, with ligament rupture

Recognition of an ankle fracture may follow the observation of edema, pain, and clinical displacement. The foot is usually everted, plantar flexed, and possibly has posterior displacement. However, all fractures are not clinically evident, and roentgenologic study will disclose the type of fracture present. All injuries to the ankle joint should have roentgenograms made to determine the exact extent of any injury to the area. Occasionally, oblique views in addition to routine lateral and anteroposterior films may be very informative.

TREATMENT

Treatment of fractures of the ankle joint consists of manipulative reduction and retention of the correction by means of a plaster cast. The closed reduction method is most desirable, and results are dependent on the skill of the surgeon and the care with which a cast is applied. The cast should be lightly padded, must fit accurately, and must be applied with care and skill; it must not be too heavy or too thick. Stockinet is used to protect the skin, and the malleoli must

not have excessive pressure on them. The cast can be applied so that the strength is anterior and on the sides. A soft heel is preferred, to eliminate the danger of



A B

FIG. 13. A—Fracture of posterior lip of tibia with intact posterior ligament of ankle joint. B—Fracture of posterior lip of tibia.

FIG. 14

FIG. 15

FIG. 14. Fracture of anterior lip of tibia, with rupture of posterior ligament of ankle joint
FIG. 15. Fracture of tibia by direct violence

pressure lesions. The heel and the peroneal nerve are protected by thin felt pads. Small pads are not desirable because they offer no dispersal of the pressure forces. In an above-knee cast, the peroneal nerve must be protected, especially on the

lateral femoral condyle where the nerve is quite vulnerable to pressure. Proper rubbing of the layers to exclude air pockets and rough surfaces, and to insure a snug fit, permits a lighter and stronger cast. The type of cast, whether below or above the knee (Fig. 17), depends on the type of fracture. The use of a walking plaster boot is appropriate in selected cases. Initial satisfactory plaster fixation does not relieve the surgeon of watchful after-care, because subsidence of edema or atrophy of the musculature may permit the cast to become loose and require replacement. A loose cast may have serious consequences, due to rotation of the foot or loss of ankle joint mortise.

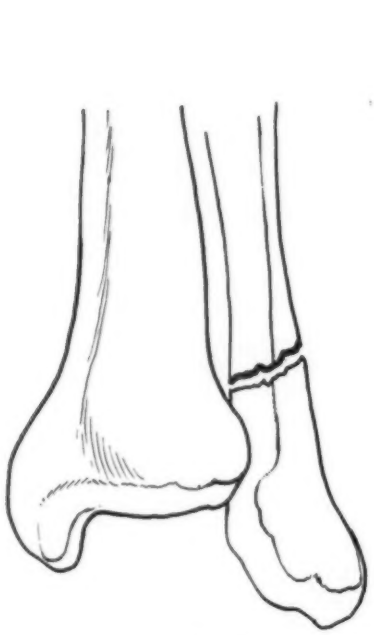


FIG. 16

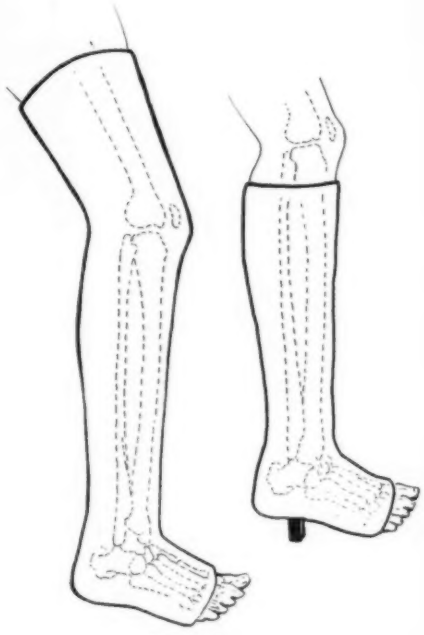


FIG. 17

FIG. 16. Fracture of fibula by direct violence

FIG. 17. Short and long leg casts. Walking iron may be incorporated in short boot only

Due to excessive edema the immediate application of a circular cast may not be advisable. Under such circumstances, a posterior plaster splint may be used. The plaster splint is weakest at the heel, and a small plaster reinforcement is advisable on either the medial or lateral side. The heel must be carefully watched in such splints for burning, pain, or sensations which indicate excess pressure that would result in a heel decubitus. The plaster splint is usually replaced by a cast as soon as the condition of the ankle permits.

A plaster walking boot is applied in unimalleolar fractures. The tendency of the foot to displace laterally, especially when the interosseous ligament is ruptured, condemns the short walking boot in these cases. Many bimalleolar fractures are very unstable and, to control rotation, an above-the-knee cast is definitely desirable. This particularly applies when a fracture of the posterior margin of the tibia is accompanied by a bimalleolar fracture. The knee is flexed

in such cases about 20 degrees, and thus rotation is controlled. Often in women who usually have a tighter heel cord than men, knee flexion and a longer cast are desirable. The long cast may be replaced by a short one in four to six weeks. Removing the upper part of the cast is not very satisfactory because, when this is done, the calf has usually atrophied and the remaining short-cast portion is loose. If the knee is released for activity, it is better to place a new short-leg cast.

The corrected position of the foot in all fractures of the ankle, except of the anterior tibial margin, is at right angles to the tibia and in neutral position as regards inversion and eversion. Any posterior displacement of the foot must be accurately corrected. Accurate anatomic reduction is essential in ankle joint fractures. Failure in this respect may result in a painful ankle, due to fragment malposition and widening of the ankle mortise. Permanent external rotation of the foot is a severe deformity and must not be permitted to occur.

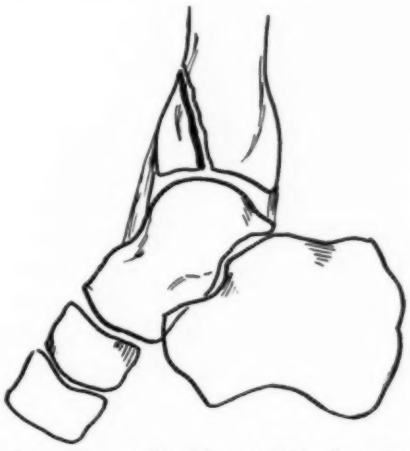


FIG. 18. Anterior lip fracture retained in position by plantar flexion of the foot

Treatment of ankle joint fractures depends on many factors. The fracture may be either with or without displacement; it may also be closed or open.

Fractures without displacement are frequently unimalleolar. They are usually of sufficient stability so that a short cast extending from just below the knee to include toe support, is sufficient. A fracture of the posterior tibial margin alone can be so treated if the fragment is not large. A stable bimalleolar fracture may be treated with a short below-knee cast. A walking iron may be included for future weight bearing. Early weight bearing is not advisable except in unimalleolar fractures. Early weight bearing occurs within the first two weeks of postreduction time. When a walking boot is used, the affected side must not be longer than the uninjured extremity; and if necessary, the heel of the good shoe for the uninjured foot may be elevated. A walking boot that is too long is extremely bad, because of the distorted weight pressure brought to bear on the ankle by the patient's effort to use it.

Anterior margin fractures occurring alone can be treated by a short cast, with the foot in plantar flexion if the fragment is not too large. This is the only fracture in which plantar flexion is advised (Fig. 18).

Anesthesia for the nondisplaced fragments is usually not necessary. However, if the pain is severe, local use of novocain or of sodium pentothal or its equivalent is desirable. Patients should not have to suffer unnecessary pain.

The aforementioned unimalleolar fractures are usually securely healed in four to six weeks, thus permitting cast removal. The bimalleolar fractures require six to eight weeks for security. After cast removal, exercises and physical therapy are instituted and walking is resumed when ankle joint activity permits, usually in from three to seven days, depending on whether a walking boot had been applied. This latter group bear weight sooner.

Ankle joint fractures with displacement require accurate reduction, and in order to accomplish this, anesthesia is a requisite. Sodium pentothal with gas or spinal anesthesia are the methods of choice. The reduction should be performed promptly, because it is better for the patient and easier for the surgeon. Eversion and posterior displacement of the foot must be corrected, and this is carried out by anatomic traction and pushing the foot forward into the normal position. The foot is placed at a right angle to the tibia and a cast applied. Because these fractures are unstable, an above-knee cast is used. The knee is flexed to release the heel cord tension, and foot rotation is prevented. A roentgenogram should be made while the patient is anesthetized and correct reduction obtained, even if the reduction and casting have to be repeated several times. This is the time to get perfect reduction and to know that it is properly maintained by the cast. If there seems to be danger of a tight cast, the cast should be split, or a long posterior plaster splint should be applied. Attempts to improve the reduction should not be postponed; the reduction should be completed at this time. This type of fracture with displacement can be treated with a short below-knee cast after four to six weeks; but if reduction has been difficult, the above-knee cast should not be removed for eight weeks. After cast removal, knee and ankle exercises are instituted for seven days, and then weight bearing is permitted. The patient is advised to wear a shoe with a stable low heel.

Fractures with displacement are occasionally open or compounded. Thorough debridement is necessary, and the skin incision should be enlarged to permit free access to the area. The ankle joint is exposed and, after debridement, the area is thoroughly irrigated with warm normal saline solution. Particular care must be taken in the cleansing of the joint area opposite the wound, because the gutter formed by the talus accumulates contaminating material. These injuries are usually seen early and primary closure is the method of choice. In a case of delayed arrival, a compound fracture is treated by debridement, allowing the wound to remain open, and covering any exposed bone to preserve its viability. In compound fracture cases, antibiotics are administered preoperatively in large doses. This is considered necessary because there is always an oozing of blood into the joint areas and if this blood contains a high concentration of penicillin, the antibacterial property of the pooled blood is increased. The antibiotics are also administered postoperatively. Tetanus antitoxin is routinely administered, after testing the patient for sensitivity.

After debridement, the fractures are reduced, and a long leg plaster splint is

applied. When the sutures are removed, if the wound is healed, a cast is applied; if the splint is satisfactory, roller plaster is applied and a modified cast obtained. Open fractures usually heal more slowly than do closed fractures. After cast application, treatment is the same as for a closed fracture. If, unfortunately, infection should follow, "you're in trouble!" Infected fractures of the ankle joint often result in loss of the body of the talus. The joint may fuse, or damage may be sufficient to necessitate amputation.

The present tendency toward operative fracture treatment can be applied to ankle fractures with good results. However, the selection of cases is important. The accessibility of the malleoli permits easy exposure, and there often is a temptation to perform surgical procedures which are unnecessary. The acute fracture which cannot be retained in perfect position by several sincere efforts at

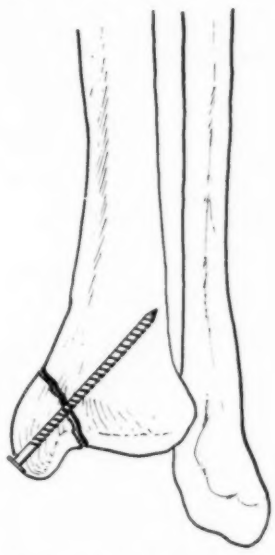


FIG. 19. Screw fixation of medial malleolus. Screw must be long and at proper angle

reduction can be fixed by malleolar screw fixation (Fig. 19). Usually one malleolus accurately fixed is sufficient for stability (Fig. 20-A and B). After such a procedure, the fracture is treated in the same manner as a closed one.

The technique of open reduction requires care and accuracy. After careful skin preparation by thorough washing with soap and water and antiseptic application, the extremity is covered with sterile stockinet. The incision for either malleolus should be curved and never over the osseous prominence. The screw should have a smooth neck of the transfixing type and should be sufficiently long to hold the reduction securely. It is important to replace the fragment accurately. Tilting the fragment creates an abnormal ankle mortise. The fibula requires special attention. The screw for fibular fixation (Fig. 21) must be placed into the tibia which is anterior, and it should be directed proximally and anteriorly in order to secure satisfactory malleolar alignment. Placing the screw is simple, but placing it properly requires care and accuracy. It is helpful to make

roentgenograms of the ankle after fixation, while the patient is on the operating table, and to correct any imperfections of replacement. To realize postoperatively that the procedure has not accomplished the intended purpose offers no satis-

A B

FIG. 20. A—Lateral malleolus fixed with screw. B—Medial malleolus fixed with screw. Note long unthreaded neck of screw.

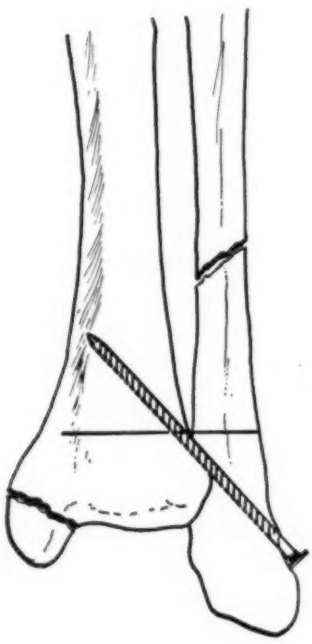


FIG. 21. The fibula must be retained by a long screw at an angle anteriorly and superiorly

faction to the surgeon or comfort to the patient. After skin closure, then plaster fixation is necessary and healing time is not decreased by surgical intervention.

The medial malleolus requires careful evaluation. After closed reduction, one may observe that the anterior portion of the medial malleolar fragment cannot be adequately reduced. The medial malleolus is frequently separated by a curtain of fibrous tissue which covers the distal end of the tibia. The ligamentous fibers

encircle the bone, and if the fracture occurs proximally to the level of the tear of the fibrous tissue level, a semicylindrical curtain of fibrous tissue is created. It is impossible to replace the fragment into the sheath from which it has been torn. This is soft-tissue intervention and an open reduction of this type of fracture is justified (Fig. 22-A and B). This particular condition is a frequent cause of nonunion of the medial malleolus.

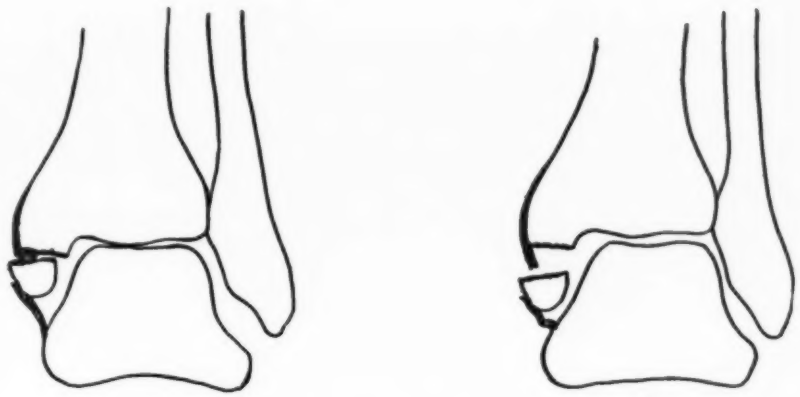


FIG. 22. Flap of ligament which has torn distal to fracture, interposing between the fragments.

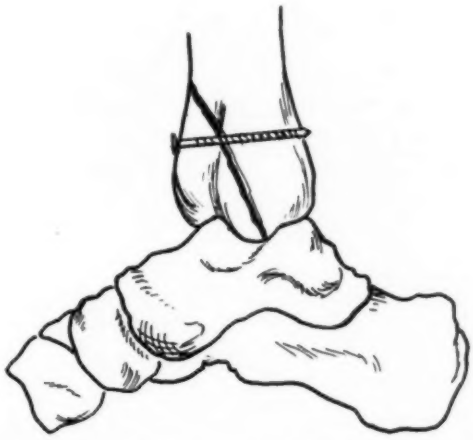
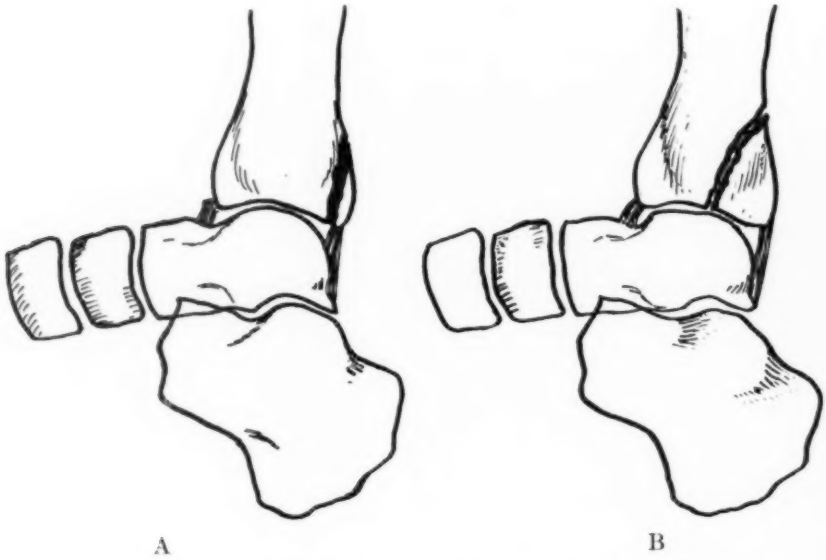


FIG. 23. Screw fixation of large anterior tibial fragment. The joint surface must be accurately re-established.

Fractures of the anterior lip of the tibia should be replaced surgically if they involve approximately one third of the articular surface. Such large fragments influence the weight-bearing articular surface of the tibia and require careful anatomic replacement and fixation (Fig. 23) in order to prevent traumatic arthritis and a painful ankle.

The posterior margin of the tibia, especially if both malleoli are fractured,

may present a large fractured lip fragment (Fig. 24-A and B). The large fragments should be replaced accurately posteriorly because of joint surface involvement. Screw fixation (Fig. 25) is best for security. In replacing these fractures, it should be remembered that the structures are not as easily approached as the roentgenogram may seem to indicate.



A B

FIG. 24. A—Small posterior tibial lip fragment retained by closed reduction. B—Large tibial fragment retained by closed reduction due to intact ligaments.

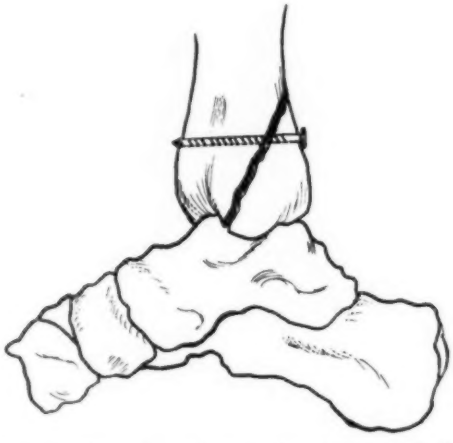
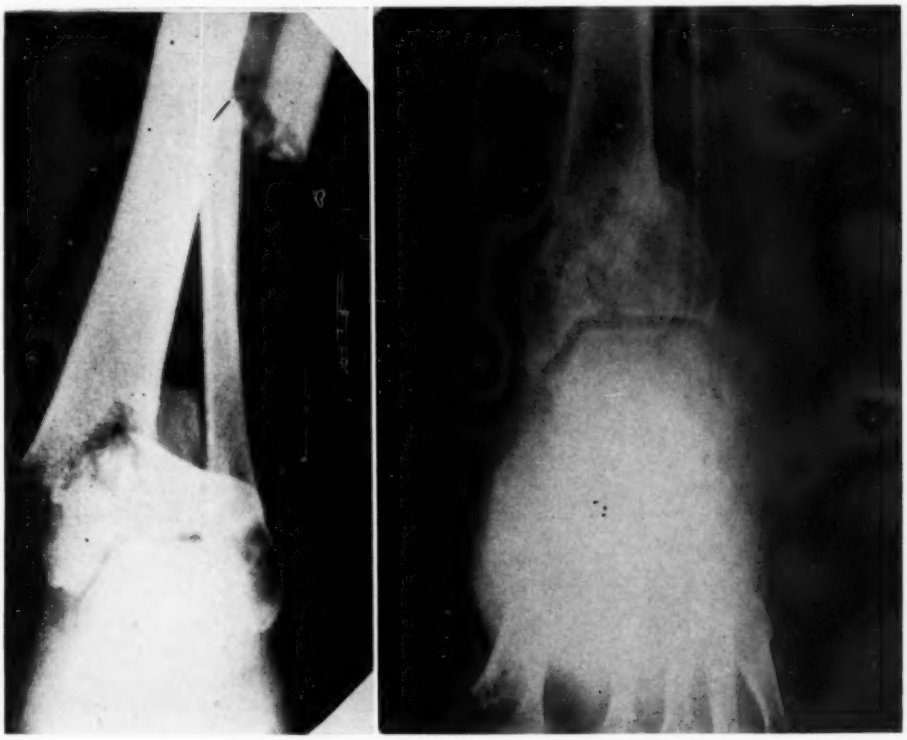


FIG. 25. Large tibial fragment retained in position by open reduction and screw fixation

Fractures including the medial malleolus which involve the tibial weight-bearing area are best treated by open reduction and fixation. It is often necessary to use a long screw which engages the opposite cortex, to secure stable fixation. Wire fixation of fractures of the ankle joint does not offer the best results.

Fractures of the ankle are troublesome when they are referred seven days or

more after trauma and are in malposition. Continuous osseous traction may reduce them but often the deformity recurs, and an open reduction is necessary. These neglected or improperly cared for fractures are often difficult, and frequently have excess fibrous tissue formation which causes marked postoperative stiffness of the ankle joint. The delay involved often causes marked decalcification of the bones of the foot, and thus the recovery period is prolonged. Overlong immobilization may cause disuse atrophy, which is not desirable.



A B

FIG. 26. A—Comminuted fracture of distal end of tibia and fibula involving the ankle joint, due to direct violence. B—Twelve weeks after continuous bone traction. Ankle joint surface damaged.

The fracture in which there has been a delay in treatment requires surgical attention to both malleoli, because of the deforming fibrosis. Surgical trauma is not preferred but is a necessary choice, and one must do his best under such circumstances.

Fractures which show large fragment displacement frequently follow the third type of violence, *i.e.*, direct force, as from a fall. This group may involve more than merely a large fragment displacement; they are often comminuted (Fig. 26-A and B) and the destruction may be very extensive. The comminuted fracture of this type will require continuous osseous traction through the calcaneus, with the knee flexed. The healing time is usually from eight to twelve weeks, and

because of the articular surface damage, results are not the best. Traumatic arthritis and ankle mortise damage are not unusual.

The healed fractured ankle with marked articular changes or aseptic areas of necrosis which cause pain and disability, requires fusion. The method of fusion calls for certain fundamental conditions, and the technique selected must meet them. Viable bone is necessary for a successful fusion. Many methods are offered and selection of the type depends on the condition of the bone of the tibia and of the talus. The wide anterior tibial sliding graft into the grooved talus offers perhaps the simplest method, technically (Fig. 27). The graft should be held by

FIG. 27. Fusion of ankle with traumatic arthritis, by means of anterior tibial sliding graft.

screw fixation and immobilized for twelve weeks. After that time, walking is permitted if union is present. If not, a walking boot is recommended in order to achieve contact compression and stability.

In direct-violence and comminuted tibial fractures, the body of the talus may be fractured. Inversion, eversion, and rotary types of trauma seldom fracture the talus. Direct forces upon the body of the talus may cause linear fractures without displacement, small marginal fragments, posterior process, vertical, and comminuted fractures (Fig. 28).

Linear fractures require immobilization for comfort.

Posterior process fractures, in the roentgenologic study, must not be confused with the os trigonum which lies posteriorly to the talus.

Comminuted fractures offer a guarded prognosis because of crushing of the

joint surface. Manual reduction by downward traction should be applied. Fusion of the joint may be required later.

Vertical fractures with displacement should be treated by manual reduction. Traction is seldom necessary, nor are open operative procedures. A plaster walking boot should not be used for fractures of the body of the talus.

For fractures of the talus, immobilization in a plaster cast with the foot at right angles to the tibia is indicated. The usual healing time is from six to eight weeks. Aseptic necrosis of the talus is too frequent. The aseptic necrotic talus may recover with prolonged nonweight bearing, but the determination of this time phase is difficult.

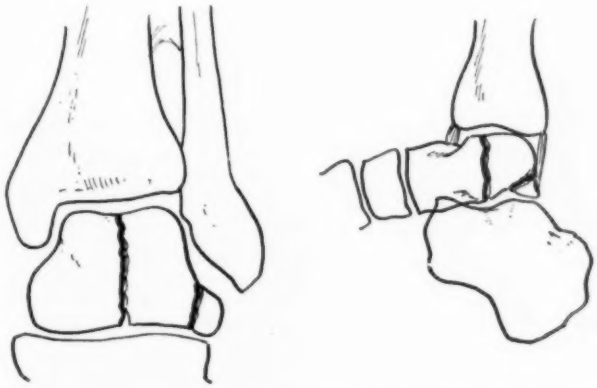


FIG. 28. Types of fracture of body of talus. Direct crushing forces often cause aseptic necrosis and painful ankle joint.

When fractures of the malleoli occur along with fracture of the talus, restoration of the ankle mortise and replacement of the talar fragments by the closed method is preferable. Fortunately, such fractures are infrequent.

REHABILITATION

Immediate treatment of a fracture and securing osseous union, with the ankle is good functional position, are the primary requisites of good fracture treatment. When this has been accomplished, it is necessary to restore the part to its normal responsibilities. Walking requires the complex coordination of the musculature of the extremity and normal activity of the entire joint system of the lower extremity, especially the foot. Physical therapy and massage are helpful, but active use of the part is the essential treatment. Edema of the dependent ankle may be prolonged, and only active use of the part will re-establish ligamentous elasticity and overcome gravitational lymphatic edema. Active use is necessary to overcome any tenosynovitis of the tendons in the ankle area. The decalcification of bone due to disuse will respond only to the physiologic effects of use. Thus, after the fracture has healed the ankle must be actively used in order to restore it to its basic function of weight bearing and walking.

Post-traumatic edema after cast removal is an important consideration. Prolongation of the edema due to gravity, varicose veins, and circulatory defi-

ciencies necessitates careful attention. Elastic bandages, gradually omitted, can be of service. Restoration of active function is perhaps the best method of reducing edema. Active motion can be supplemented by massage of the musculature and the use of heat, so as to secure relaxation of the rigid type of musculature often evident in older persons.

The return to weight bearing can be a significant problem. Often, the elderly are unable to use crutches; therefore, such apparatuses as parallel walking-bars or mobile walkers are necessary. Mobilization should never be attempted except when the patient has an attendant, to prevent additional trauma. One must accept the fact that in the elderly person, return to function of a fractured ankle joint often requires more time and patience than the immediate care of the fracture.

Acknowledgments

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SUPRADIAPHRAGMATIC VAGOTOMY IN THE TREATMENT OF GASTROINTESTINAL ULCERATION

Report of 100 Consecutive Cases

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Since Dragstedt and Owens (1) in 1943 described the treatment of duodenal ulcer by supradiaphragmatic section of the vagus nerves, the procedure has been widely debated. In this paper the author is reporting upon 100 patients with gastrointestinal ulceration who were treated surgically since 1946 by supradiaphragmatic vagotomy, either alone or combined with posterior gastrojejunostomy or partial gastric resection.

The great majority of duodenal ulcers respond to adequate medical treatment. Allen (2), and Allen and Welch (3) state that only 15 to 20 per cent require surgery. Those duodenal ulcers which do not respond to adequate medical therapy, and complications such as obstruction, perforation or hemorrhage, require surgical treatment either by vagotomy and posterior gastrojejunostomy or by partial gastric resection. In a previous publication the author (4) has described the surgical treatment of duodenal and gastrojejunal ulcers by supradiaphragmatic vagotomy.

The medical treatment of peptic ulcer is aimed at 1) reduction of acidity, 2) reduction of secretion, and 3) reduction of motility. All three of these factors are excessive in the ulcer patient.

In 1949 the author reported (5) that in our first 33 cases the free acidity of the gastric contents averaged preoperatively 53.6 degrees and postoperatively 3.3 degrees. Thirty patients had no free acid. In 3 patients, therefore, the vagotomy was not complete, since free acid was present postoperatively. The Hollander insulin test preoperatively showed an average acidity of 64.2 degrees and postoperatively 1.7 degrees. The average volume of night secretion preoperatively was 576.7 cc., whereas postoperatively it was 336.7 cc.

Vagotomy, therefore, reduces free acidity and the volume of night secretion. Likewise it reduces the motility of the stomach, in some cases to such a degree that the patients suffer gastric distention and retention of food for several months. This is less marked when vagotomy is accompanied by gastrojejunostomy or partial gastric resection.

Dragstedt and co-workers (6) showed that complete division of the vagus nerve supply to the isolated stomach of the dog reduced the output of hydrochloric acid by an average of 76 per cent.

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The phases of gastric secretion

There are three phases of gastric secretion, namely:

	Normal dog (Dragstedt)	Duodenal ulcer patient
1. Vagal, nervous, or cephalic	45%	80%
2. Hormonal, antral, gastric or chemical	45%	15%
3. Intestinal	10%	5%
	100%	100%

Dragstedt showed that, in the normal dog, the vagal phase probably accounts for 45 per cent of the total amount of gastric juice secreted in twenty-four hours, the antral phase for 45 per cent, and the intestinal phase for 10 per cent or less. He has further shown that in duodenal ulcer patients, the nervous phase probably accounts for 80 per cent of the gastric juice secreted, the antral phase for 15 per cent, and the intestinal phase for 5 per cent.

From the foregoing it would seem that since 80 per cent of the secretion is associated with the nervous phase, vagotomy would be a logical procedure, rather than a wide resection of the stomach to control the antral phase, which accounts for only 15 per cent of the secretion.

Indications for vagotomy

Success of any operation depends primarily upon the indications for which it is performed. There probably have been many vagotomies performed without proper indications, and most likely with poor results. Moreover, frequently all the vagal fibers have not been severed. This is not a reflection upon the operation, but upon the operator. However, a certain percentage of patients will have anomalous vagal fibers which can be missed by the most expert vagotomist. There were several such occurrences in our first 100 cases, as revealed when the Hollander insulin test was run postoperatively. Some patients reported by the radiologist as having gastrojejunal ulcer following vagotomy were found to have a high degree of free acid. We cannot say that a marginal ulcer developed after vagotomy, because the patient did not have a complete vagotomy in the first place. Some of these patients have been re-explored and additional vagal fibers found.

The following indications for vagotomy are being used at the present time:

1. Marginal, anastomotic, or jejunal ulcer
2. Duodenal ulcer
    A. Benign pyloric obstruction
    B. Previous perforation
    C. Previous repeated attacks of hemorrhage

We do not perform a vagotomy during the active bleeding phase. The patient is treated medically and then a vagotomy is performed as an elective procedure. In some cases of massive hemorrhage, however, resection has to be carried out as a life-saving measure.

Age and sex

The average age in the author's series was 46.7 years. The oldest patient was an 82-year-old male with a marginal ulcer following gastrojejunostomy. He had suffered repeated hemorrhages. A vagotomy was tolerated, when a more radical operation might have been fatal. The youngest patient was 22 years old; 37 patients were over 50 years of age.

There were 82 males and 18 females in the series.

Preoperative tests and preparation

The amount of night secretion from 8 p.m. until 8 a.m. should be recorded and tested for total, free and combined acidity. This can be accomplished by inserting a Levine tube connected with a Wangensteen suction apparatus, collecting the secretions in a bottle. If possible, this measurement should be repeated. Repeated Ewald meals are likewise desirable.

The Hollander insulin test should be run on all patients if possible. At 8 a.m. blood should be taken for a fasting blood sugar determination; then a dose of 15 or 20 units of regular insulin is given intravenously. The amount of secretion and the total, free and combined acidities are recorded at 8:30, 9:00, 9:30, 10:00, and 10:30 a.m. At 9:00 a.m. the blood sugar concentration is again determined.

The patient should have, in addition, the routine preoperative tests and preparation and should go to the operating room with a Levine tube in the stomach.

Postoperative care and studies

Routine postoperative care is given after gastric surgery. Wangensteen suction is continued for five days. Decompression for five days is important, in order to offset gastric distention. Night secretion is collected, measured, and tested for acidity each night the tube is in the stomach, in the same manner as preoperatively. The Hollander insulin test is repeated. If no free acidity is found after this test the surgeon feels reasonably assured that he has severed all the vagal fibers; this apparently is necessary in order to obtain the desired results in treating gastrointestinal ulcerations. After removing the Levine tube, the patient is given small amounts of liquids.

A Levine tube is inserted into the stomach each night after the first five, and the stomach aspirated. If more than 100 cc. of secretion is obtained, the tube is left in overnight with suction. When less than 100 cc. is recovered, aspirations are discontinued. Liquids are gradually increased until the patient is graduated to soft food and finally to a general diet. Patients are instructed to stop eating whan gastric distention occurs and to eat small amounts frequently until they can tolerate a general diet.

Surgical procedures employed

Intratracheal gas anesthesia following sodium pentothal induction is preferred by us.

The first 5 cases in our series were operated upon by the transthoracic approach and the remaining 95 by the transabdominal approach. The transthoracic

procedure has been abandoned almost universally, since the surgeon is not given the opportunity to explore the lesion. It may, however, have a place in the treatment of marginal ulcer when the stoma is adequate. The transabdominal approach with a posterior gastrojejunostomy is now employed. This approach allows the surgeon to explore the lesion and perform an emptying operation.

Three patients had gastric ulcers. All 3 underwent vagotomy plus partial gastric resection. The anterior polya procedure was used in 1 instance, and the posterior polya in the remaining 2. Both of the latter patients suffered from the "dumping syndrome." When vagotomy is supplemented, more of the stomach is left in and the patients do not suffer the nutritional disturbances which may occur when a high resection is performed.

Thirty-eight of the patients had uncomplicated duodenal ulcers. Nineteen had suffered from previous hemorrhage, 12 from previous perforation, and 19 from benign obstruction. Six patients had marginal or jejunal ulcers—3 following gastric resection (four years, four months, and ten months later, respectively) and 3 following gastrojejunostomy (thirty years, three years and twenty-two months later, respectively).

One patient had a duodenal ulcer, with a pin surrounded by inflammatory tissue in the pyloric end of the stomach, simulating a neoplasm. Gastric resection and vagotomy were performed. This case has been previously reported by the author (7).

One patient, operated on elsewhere, was reoperated on by the author, and additional vagal fibers found. One patient previously operated on by the author was reoperated on and additional fibers found.

Two patients had repair of gastrojejunocolic fistula combined with a vagotomy. The technic of this repair has been reported by the author (8) in a previous publication.

Vagotomy alone was performed in 22 patients. Vagotomy combined with posterior gastrojejunostomy was performed in 70 patients, vagotomy plus partial gastric resection in 6, and repair of gastrojejunocolic fistula supplemented by vagotomy in 2.

Mortality

No immediate deaths occurred after surgery among the private patients in our series of 100 vagotomies. There were 2 deaths in the series, which could be directly attributed to surgery. One was in a 58-year-old male who died from atelectasis of the lung on the ninth postoperative day following a repair of an evisceration of his vagotomy wound. A vagotomy and posterior gastrojejunostomy had been performed for an active duodenal ulcer of eight years' duration. The second death occurred in a 46-year-old male. This patient was in shock when operated upon the second time for acute bowel obstruction and he died on the third postoperative day. A vagotomy and posterior gastrojejunostomy had been performed three days before for previous hemorrhage from duodenal ulcer.

Eight patients died from two months to three years after operation, from other causes.

Complications

Gastric distention with retention of food, and sometimes with belching of a foul odor, is the most frequent postoperative complication. This complication is usually relieved by postoperative decompression with Wangensteen suction for five days, urecholine (one tablet three times daily before meals) and instructions to the patient regarding diet.

Diarrhea has not been a troublesome complication in our series. It was usually transitory; in only 1 patient did it necessitate rehospitalization. Dilute hydrochloric acid (10 drops in water sipped during meals) and urecholine usually correct it.

The technical error of trauma to the spleen, causing hemorrhage, accounted for splenectomy in 5 cases.

Wound disruption occurred in 6 patients and wound evisceration in 2. One of the postoperative deaths was due to an evisceration.

Cardiospasm occurred in 2 patients. Etamon (tetraethylammonium chloride) relieved the most severe case. Symptoms in both subsided in three weeks.

A hiatus hernia, which was later repaired, occurred in 1 patient. We have attempted to suture the hiatal opening in the diaphragm, following this experience.

A vicious circle occurred in 5 patients following posterior gastrojejunostomy, lasting in 1 patient for twenty-one days. With fluids, electrolytes and suction this complication corrected itself in all cases.

Two patients were revagotomized when symptoms recurred and when the Hollander insulin test revealed a high degree of free acid, indicating that all the vagal fibers had not been severed.

The "dumping syndrome" occurred in 2 patients. In both, a posterior polya-type partial gastric resection had been performed. The author prefers an anterior polya-type of gastric resection because, in his opinion, fewer "dumping syndromes" occur. This condition improved in time in both instances.

Two patients suffered occasional periodic severe attacks of abdominal pain. Gall bladder visualization by roentgenogram revealed cholelithiasis. Jejunal ulcer was diagnosed elsewhere in 1 patient. Direct inspection revealed no jejunal ulcer at operation. Cholecystectomy relieved the distress in both patients.

This may seem like a high percentage of complications, but most of them occurred in our earlier operative cases. Experience has been gained and in the last 50 patients in the series fewer complications have developed.

Late results

A close personal follow-up of 97 cases in our series has been obtained, covering the period from 1946 to the present. We were unable to follow 3 cases. The patients were asked a series of questions and then asked if they considered the clinical results of their operation good, fair or poor. Seventy-seven reported that their previous gastric symptoms had disappeared and considered the result of the operation to be excellent or good. Eleven reported fair results, since some gas and fullness occurred with dietary indiscretions. Although on the whole they

were much improved and satisfied, 9 reported poor results. Therefore, 88 of the 97 patients questioned were satisfied with the result of the operation.

DISCUSSION

It is of primary importance that patients on whom vagotomy is to be performed should be selected with wisdom. Results are best in patients with benign obstruction and previous perforation, and marginal ulcer with adequate stoma. The results in neurotic and frustrated individuals, usually females, are poor. Experience will teach us which patients should have a vagotomy and which should have another surgical procedure, if any.

The success of vagotomy depends primarily on severing all vagal fibers to the stomach. This is sometimes impossible, however, even in the hands of the most expert surgeon.

In our series of patients, when marginal ulcers were reported by the roentgenologist, they were not always present, as we found at secondary operations. When marginal ulcer was present, in rechecking the patient's acidity, it was found that a complete vagotomy had not been performed. Some of these patients have been reoperated on and vagal fibers have been found which were missed at the first operation.

The mortality of vagotomy is lower than that of some of the other procedures. A chronic duodenal ulcer which has distorted the duodenum and common bile duct and has penetrated into the pancreas, will respond to complete vagotomy and gastrojejunostomy with lower morbidity and mortality than to gastric resection; in the latter instance, the common bile duct may be injured or the diseased duodenal stump may perforate.

Older patients can probably tolerate this operation better than a more radical procedure, because in many clinics the operative mortality for vagotomy is less than 1 per cent, whereas for gastric resection it is 2 per cent or more.

Patients who have been vagotomized require closer and longer personal follow-up. The patient who is advised in advance of the complications which may arise, usually accepts them, should they occur.

SUMMARY AND CONCLUSIONS

1. One hundred patients, aged from 22 to 82 years, with gastrointestinal ulceration have been treated by supradiaphragmatic vagotomy alone, or combined with posterior gastrojejunostomy or partial gastric resection. An analysis of the cases is presented.
2. The phases of gastric secretion and experimental studies are discussed.
3. Indications for vagotomy are given and the procedure is evaluated.
4. The importance of severing all vagal fibers, if possible, is stressed.
5. Preoperative and postoperative tests, preparation and care are emphasized.
6. Postoperative complications of vagotomy and methods for their alleviation and prevention are discussed.
7. Clinical results are given from personal follow-up of 97 patients, from 1946 to the present.

8. Supradiaphragmatic vagotomy and posterior jejunostomy, in our hands, has been a satisfactory procedure.

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PLEBOTHROMBOSIS AND THROMBOPHLEBITIS IN THE AGED

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This article is a partial summary of current literature on venous thrombosis with the author's version of correct present-day management of this problem, applied particularly to the person past 50 years of age. Any general statement that may depict the hazards or the need for care in preventing and treating thromboses, becomes decidedly apropos when applied to the older age group.

INCIDENCE

In spite of modern knowledge, new drugs, improved anesthesia and improved surgical technic, there has been a progressive increase throughout the years of the incidence of venous thrombosis. According to Ochsner *et al.* (1), venous thrombosis was two and a half times as frequent in the year 1948–49 as it was in the year 1938–39 at the Charity Hospital in New Orleans. Similar results have been reported from the Massachusettes General Hospital in Boston. No adequate explanation has been offered, but the increased life expectancy of a person living in the present decade compared to that of ten or twenty years ago is likely a strong factor, as these added years of life are the ones in which the highest incidence of thromboses is found.

Since this condition is often difficult to diagnose, and since there are so many variable factors that play an important role (such as age and cardiac condition), statistics on the incidence of thromboses vary considerably. Ochsner (1) in a recent summary of 582,726 admissions to the Charity Hospital from 1938 to 1949, found 1,002 cases of thrombo embolism, or about 1 in each 600 cases admitted (0.17 per cent). He reported 411 fatal cases of pulmonary embolus—an incidence of .071 per cent of total admissions. Of particular interest was the age groups that were involved. The highest incidence of thrombo embolism was in the fifth decade, whereas fatal pulmonary embolisms were most frequent in the seventh decade. Of the cases of thrombo embolism, 37.3 per cent occurred on the medical services but the incidence of fatal pulmonary embolism among these cases on the medical service was 62.3 per cent. McCartney (2) reported death due to pulmonary embolism in 2.67 per cent of 25,771 necropsies from 1919 to 1939. Ochsner and associates (1, 3) found the postoperative incidence of thromboses to be about 0.6 per cent. Kerr (4), however, estimated the average overall postoperative incidence to be 1½ to 2 per cent. In general, we estimate the postoperative incidence to be from 1 to 2 per cent and that fatal pulmonary embolism occurs in about 0.1 per cent of all postoperative cases.

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DIFFERENTIAL DESCRIPTION OF THE THROMBOSES

Formerly some clinicians thought phlebothrombosis and thrombophlebitis were merely different phases of a single process but evidence is abundant that they are different entities and should be treated as such. Thrombophlebitis is a thrombosis with associated inflammatory changes in the vascular endothelium. The basic clot is a white or mixed thrombus made up essentially of platelets and leucocytes *firmly* attached to the vein. There may be a friable "tail" on the white clot which may break off and produce an occasional small embolus.

Phlebothrombosis, on the other hand, is a quiet clotting of blood in the vein, forming a red clot which has a minimal inflammatory reaction and a minimal attachment to the vessel wall. This condition constitutes a more dangerous condition and is usually due to, or associated with circulatory stasis and increased coagulability of the blood. Likewise, this condition is more prone to produce the larger and more serious emboli. Bible (5) states that pulmonary infarction is caused by small and short detached clots, whereas most fatal emboli are larger (10 to 12 inches long) or composed of many short thick fragments.

ETIOLOGY

Basically, anything that tends to retard circulation favors formation of a thrombosis and, conversely, any factor that prevents retardation of circulation tends to prevent thrombosis. There are two important factors in the hydrodynamics of the circulation that play important roles in this problem: 1) the negative suction of the thorax during normal respiratory excursions, which facilitates the movement of venous blood towards the heart, and 2) the accessory pumping action of skeletal muscles which, by squeezing the veins, forces the venous blood towards the heart. Any diminution or impairment of these forces will tend to retard circulation and favor thromboses.

Increasing age and cardiac impairment go hand in hand and undoubtedly constitute the two most important etiologic factors. Hunter and his associates (6) found at autopsy that thrombosis of the deep veins of the leg occurred in 52 per cent of middle-aged and old persons who had been in bed for varying periods of time. In Miller and Rogers' (7) series, 50 per cent of the patients were over 50 years of age. In Veal and Hussy's (8) 84 cases, 70 per cent were over 40 years of age. Allen (9) reported that 82 per cent or more of his patients with venous thrombosis were above the age of 40. Koch (10) found that between the ages of 15 and 19 years of age, the circulation time averaged eighteen seconds; between 30 and 40 years of age, it was twenty-one seconds and at 70 years of age, it was twenty-three seconds. In patients in whom there was a circulatory disturbance, the circulating time was frequently as much as sixty-one seconds, and after operation there was a definite interference with circulation.

Ample evidence may be found in the literature to correlate heart disease and increased venous thrombosis. Ophüls and Dobson (11) found cardiovascular disease in 52 per cent of their cases of thrombosis and embolism. Putnoky and Farkas (12) found that 90 per cent of their 91 patients with pulmonary embolism

had cardiovascular disease. Various other investigators have reported that between 50 and 90 per cent of their cases were associated with heart disease.

There is a seasonal influence on thrombosis; it is somewhat more likely to occur with a falling barometer. Spring and fall are seasons generally considered to show the most thromboses. In colder climates the incidence of thrombosis is almost twice as high as the warmer climates. Ochsner (13, 14) states that the average incidence in northern clinics is 0.74 per 100,000 population as contrasted with a rate of 0.41 in the southern states. This increased incidence in colder environment may be due to the vaso-spastic influence of cold.

There is a known constitutional predisposition to thrombosis, found more commonly in the adipose, asthenic, weak-muscled, pale-skinned individual. One should be more suspicious when dealing with an individual in this category. In a large series of cases, the incidence of pulmonary embolism was about twice as high in those patients weighing more than 200 pounds as it was in those that weighed less than 200 pounds (15).

Smoking, by producing vaso-spasm, tends towards thrombosis by retarding circulation through the extremities. Varicose veins, with their stagnation of circulation, have the same effect (16).

Any debilitating condition such as malignancy, anemia, sepsis, liver disease, or nephritis, predisposes to thrombosis by altering the blood so that it clots more readily; in fact, diagnostic tests for cancer are often based on the increased clotting tendency.

Surgery and trauma are precipitating factors; they cause damage to the endothelial lining and also result in tissue toxicity and anoxia in the involved area.

Even though the exact clotting mechanism of the blood is not known, there are certain inherent changes which increase the clotting tendency. The agglutination of thrombocytes is used as a measure of clotting activity. The number of thrombocytes is increased postoperatively. It has been found that the increase in platelets parallels the magnitude of the operation and the tendency towards intravascular clotting. According to Heuch and von Seemen (17), there occurs during the first five days postoperatively, a decrease in the number of platelets; this decrease is followed by a massive increase from the eighth to the eleventh day.

SIGNS AND SYMPTOMS

The signs and symptoms of thrombophlebitis are definite, and readily recognizable as a rule. There is pyrexia, pain along the course of the involved vein and swelling of the affected extremity, with pain or cyanosis. The pain has been thought to be due to anoxia associated with vaso-spasm and is promptly relieved by improving the circulation by a lumbar sympathetic block with novocaine.

Phlebothrombosis, on the other hand, is usually extremely difficult to diagnose, often presenting itself initially by the appearance of a fatal or non-fatal embolus. Often the patient has a sense of impending disaster. There may be an increased pulse rate with little or no elevation of temperature. Examination of the legs may disclose tenderness of the calves to squeezing, or a positive Homan's sign (ten-

derness in the calf on dorsiflexion of the foot). There is usually no pain, swelling or fever.

TREATMENT

Treatment may be divided into two large categories: 1) prophylactic and 2) remedial. Prophylaxis starts with the doctor being aware of the possibility of a thrombosis. He should take a careful history to see if any previous episodes might have been experienced by the patient. Varicose veins should either be treated or obliterated by an elastic bandage. A cardiac condition should be improved to its maximum before operative procedures. Anemia should be corrected and sepsis minimized or eliminated when possible. Excessively heavy patients should lose weight before elective surgery and likewise bad-risk patients should have elective operations timed to coincide with favorable seasons. An attempt should be made to have patients either stop or decrease smoking as much as possible before entering the hospital and particularly postoperatively. Posture during surgery and postoperatively should promote optimal circulation. Pillows behind the knees and arranging the bed so as to have the knees flexed tend to retard circulation, whereas slight elevation of the foot of the bed improves circulation. The encouragement of early ambulation is an important factor, as this stimulates improved respiration, helps clear the chest of mucus and prevents stagnation of blood in the legs by muscular action. The exercise in itself increases the rate of circulation by increased cardiac output and, unless for some reason it is contraindicated, should be encouraged as early as possible. Since embolic accidents are more prone to occur after the fourth or fifth day, ambulation or exercise should be instituted by this time. For those patients who are unable to get out of bed or in whom ambulation is contraindicated, a course of exercises in bed, as well as deep breathing, should be prescribed. Surgery should be as careful and atraumatic as possible, and an attempt should be made to avoid mass ligatures with their attending necrosis of tissue. The choice of suture material does not seem to be of much importance in the prevention of thrombosis. Anatomic or transverse incisions probably are of value, because of their greater strength and safety with respect to early ambulation. Good judgment is a factor in preventing complications. For example, it might be better to perform a double hernia operation in two stages in a poor-risk patient than to perform the two operations at the same time. On the other hand, it might be less hazardous from a thrombotic viewpoint to perform a one-stage colon resection than to carry out a multiple-stage procedure.

Tight abdominal binders and dressings should be avoided and drugs that diminish the cough reflex should be given sparingly. The sooner one maintains normal clear respiration the better will be the circulation and the less the tendency toward stasis.

The clinician will do well to examine the legs daily for tenderness to pressure or dorsiflexion, whether the patient be medical or surgical. If positive evidence is present, one must decide upon his course of definitive treatment.

The definitive treatment of thrombophlebitis is well established, easily and quickly attained, and is so satisfactory that it is almost inexcusable to deny the patient the benefits of a lumbar sympathetic block with procaine as soon as the diagnosis can be made. In the majority of early cases, the relief of symptoms is so definite and sudden that it amazes the patient and the clinician who is trying this procedure for the first time. Treatment is not only aimed at relieving the primary condition, but likewise and probably more important, at preventing a circulatory cripple in the future, as an end result of the phlebitis. Because of the firm attachment of the clot to the vein, there is little danger of embolus formation and the usual sympathetic block relieves the condition so promptly that other treatment, such as anticoagulant therapy, is seldom needed. Ochsner (3) states that in 90 per cent of cases, a single block is sufficient, but in 10 per cent a second injection is necessary. Sixty-five per cent of the patients are afebrile in forty-eight hours and another 24 per cent in from three to five days. Edema subsides within four days or less in 56 per cent, and in from five to eight days in an additional 32 per cent. The longer one waits on a thrombophlebitis before initiating therapy, the poorer the results and the more prolonged the treatment. I have often wondered why the average physician is hesitant about using sympathetic blocks. It is a simple, safe procedure that can be accomplished in the office, home or hospital. If this paper accomplishes nothing more, I hope it encourages the general practitioner to perform some blocks and become familiar with the good results.

I shall briefly state my procedure as simply as possible. When facilities are available, it is preferable to give the patient a light dose of pentothal sodium, as many patients are fearful of long needles being inserted into the back. A 20-gauge, long spinal needle is used, as it is stiffer than a smaller needle and the direction can be controlled more easily; moreover, when it is time to aspirate, it is easier to judge if the end of the needle is in a vessel. The patient should lie on his side with knees flexed towards the abdomen; the side to be treated should be uppermost. A dermal wheal is raised with 1 per cent novocaine, three finger-breadths lateral to the spinous process of the fourth lumbar vertebra. The needle is angled at about 15 or 20 degrees towards the spine and inserted until the point of the needle strikes the transverse process. It is then withdrawn and inserted another inch or an inch and a half, over or under the transverse process, to strike the body of the vertebra. It is again withdrawn and the angle changed so as to slide over the body of the vertebra about one-half to three-quarters of an inch. Then aspiration is tried, with a 10-cc. syringe filled with 1 per cent novocaine. If no blood or spinal fluid is aspirated, 2 cc. of novocaine is injected and the aspiration repeated. As a precaution, the aspiration should be repeated after the injection of each 2 cc. of novocaine. The process is then repeated lateral to lumbar vertebrae 3, 2 and 1, injecting 10 cc. of novocaine into each area. Occasionally one will enter the inferior vena cava on the right, or a vertebral vein, but by withdrawing the needle a short distance no serious damage is done. It is not necessary to reach the ganglia—one merely floods the area near the ganglia with novocaine. Changes in skin temperature are usually evident within ten to thirty

minutes and often are easily detectable with the bare hand. A rise in temperature of 10 to 18 degrees (thermocouple reading) in the foot on the injected side is not uncommon, and usually there is clinical improvement that lasts for several days or weeks. Again let me emphasize—the earlier one does a sympathetic block, the better the results. Priscoline and allied drugs are a poor substitute for sympathetic block.

A brief word only will be said about "septic thrombophlebitis." Because of its rarity, it is hardly of concern to the average practitioner. Basically the septic process liquefies the clot and allows septic emboli to break loose and produce septic infarcts. It usually is pelvic in origin and requires early drastic surgical ligation of the inferior vena cava and ovarian veins, along with a bilateral lumbar sympathectomy and antibiotics.

It is with regard to the treatment of phlebothrombosis that the present contention exists. Heroic efforts have been made throughout the world to limit or eliminate the dread embolic catastrophies. To date the treatments leave much to be desired. In general, there are three schools of therapy: 1) surgical, 2) anticoagulants, and 3) neither.

The surgical approach is based on the contention 1) that a clot is present in a vein, and 2) that it can be diagnosed; after which, ligation of the vein above the clot is in order. The difficult problem at the present time is not only to diagnose the condition but to determine what vein or veins contain loose clots. Then bilateral ligation of veins at various levels is performed; but even after the ligations, there is still no assurance that emboli will not occur.

The question about which many are concerned is whether to perform prophylactic superficial femoral ligations in all bad-risk patients or to perform ligations only in those cases in which a diagnosis of phlebothrombosis can be made. After a patient has suffered one warning embolus, many think it a serious neglect if an immediate ligation is not undertaken. The greatest criticism falls on those who routinely sacrifice veins as a prophylactic precaution. The critics say that, if other factors are watched, the incidence of embolus will not be high enough to warrant the eradication of so many normal veins, with the undesirable end results.

The main anticoagulants used are heparin (prepared from beef lung) and Dicumarol (originally prepared from sweet clover). The heparin has the advantage of quick action and also has a safety factor, in that it can be neutralized quickly. It has the disadvantages of 1) requiring constant laboratory control, 2) being expensive, 3) requiring prolonged treatment and hospitalization, 4) causing unplanned hemorrhage, and 5) requiring repeated administration, usually by intravenous route. The action of heparin is as an antithromboplastin, an antiprothrombin and an antithrombin; it also decreases platelet agglutinability. This action is of about four hours' duration. There are several forms available, that may be given as "depot" heparin with prolonged action.

Dicumarol, which was originally derived from sweet clover but is now synthesized, has two advantages: 1) it is less expensive and, 2) may be taken orally. It acts more slowly than heparin, requiring twenty-four to forty-eight hours to

reach its maximum effect. Moreover, there are certain individuals who seem extremely sensitive to it, and others who are quite refractory. It also requires constant laboratory supervision, its activity being measured by prothrombin time. It is desirable to maintain the prothrombin activity at 10 to 30 per cent of normal. Most hospitals now have a stable standard and are equipped to run the controls. This method of treatment is not without danger from hemorrhage and requires prolonged treatment.

Anticoagulant therapy has many proponents and is widely practiced in Sweden. A report (18) from Mariestad Hospital, Sweden, on intravenous heparin treatment of 209 cases of acute thrombosis among 16,495 admissions over a five-year period showed the number of operations to be about 7,000 without a single postoperative death from thrombosis or embolism. There was a mortality of 3 cases in the group not operated on. In a previous five-year period, there had been 47 deaths from embolism.

Burton (19), in an analysis of results from Michigan Medical School, reported a series of 439 surgical cases treated with anticoagulants. There was undesirable bleeding or progression of the thrombosis in 23.6 per cent of the cases. There were 3 instances of fatal hemorrhage. In addition to these undesirable results, there were some patients who had a recurrence of the thrombosis on discontinuing the anticoagulants.

In another series at Michigan, treated by ligation with subsequent follow-up, a majority of the patients had varying degrees of edema following normal or unusual activity. A few were plagued with pain, induration, inflammatory reaction and ulceration in recurrent episodes, and 38 per cent found their usual or desired activity limited to some degree by pain or discomfort in the extremity.

CONCLUSION

Whether the definitive treatment of phlebothrombosis should be surgical or medical is a matter of personal opinion. Present methods of therapy leave much to be desired. The prophylactic measures mentioned constitute the most logical approach to the problem.

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THE TRAGEDY OF OVARIAN CANCER*

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Gynecologists, as a group, can be proud of the achievements of the past fifty years in the treatment of uterine carcinoma. Since the year 1896 when John Clark first advocated radical surgery and since 1898 when Wertheim developed his operation for cervical cancer, we have seen a tremendous reduction in the mortality due to this disease. In 1911 Wertheim reported 500 cases of cervical cancer with an 18 per cent five-year survival rate. The introduction of radiation therapy in the "twenties," along with the advances in technique, increased this survival rate to 30 per cent by 1935. The "thirties" witnessed increasing discussion on the early diagnosis of the lesion. Adequate inspection of the cervix, aided by the Schiller test and the colposcope led to more frequent early diagnoses, with a greater survival rate. The "forties" brought to the foreground the value of cervical and vaginal smears, early and repeated biopsies, the role of surgery in the treatment of the disease, and the value of routine yearly pelvic examinations We now (1950) find a survival rate of 50 per cent—an expected one in all cases of cancer of the cervix. Today we see more early lesions and we have the "know how" for treating them successfully. We can see a broad future with the advent of the patient's increasing awareness of early symptoms and of the value of yearly health check-ups, the increase in the number of adequately trained surgically experienced gynecologists, the probable advances in atomic medicine, and the tremendous financial impetus given to cancer research.

However, when we come to ovarian cancer, we must hide in the background. In spite of the advances just mentioned, 80 per cent of patients with ovarian cancer die. In 1945, 4,386 American women (1) died of cancer of the ovary. This number was equal to the number of deaths associated with obstetrics in that year. In the years 1948 to 1950, 400 patients with cancer of the ovary were reported to the New York State Department of Health (2); 88 per cent of these patients died. In contrast, 961 patients with cervical cancer were reported, with a death date of 50 per cent.

In 1932 Heyman (3) found that 32 per cent of patients with ovarian cancer survived five years. In 1940 Pemberton (4) noted an identical result. Meigs (5), in that year, found that only 16 per cent of his patients with ovarian cancer survived. In 1951 Schmitz (6) found that only 20 per cent lived and Munnell (7) reported 27 per cent. Twenty years of reports and no progress.

Gynecologists are well aware of this distressing picture and of the problem ahead. This hopeless experience to date calls for a concerted effort by all of us toward future attack. Just as we who are gynecologists must become familiar

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with geriatric problems, you who are geriatricians per se must become familiar with gynecologic problems. Fortunately this rapport between our groups does exist. Just witness the presence of a gynecologist as program chairman of this meeting, and the presentation of many papers on gynecology.

The majority of cases of ovarian cancer (8) arise in women between 50 and 60 years of age. Sixty per cent occur after the menopause. Less than 20 per cent occur in women under 45.

The symptoms of ovarian cancer are unfortunately always "too little and too late." Abdominal enlargement, abdominal pain, loss of weight, weakness, and occasionally irregular vaginal bleeding are the usual complaints. Usually the malignant growth is well advanced when the patient presents herself with these symptoms. The duration of the symptoms has no effect on the prognosis. Patients have been found to possess inoperable advanced lesions, with symptoms of only a few days' duration. On the other hand, good results have been obtained occasionally on patients with complaints of four to six months' duration.

Today my interest is not to acquaint you with the pelvic findings or the refined diagnostic points in distinguishing ovarian cancer; nor is it to discuss the refinement of treatment. We know that ovarian cancer must be considered whenever one notes a large pelvic tumor or ascites and that once the diagnosis is established, radical surgery with conjunctive radiation therapy is the only treatment.

My purpose is first of all to awaken your interest in this problem, to acquaint you with the present incidence of the disease and its high mortality—and to consider the steps by which all of us can, in the present state of our knowledge, improve the early recognition and successful treatment of cancer of the ovary.

With the foregoing discussion in mind, the next step would be to consider the value of routine repeated physical examinations as a "prophylactic" measure in early diagnosis. Certainly pelvic examinations repeated every six months would lead to a utopian existence. However the entire public is not yet aware of the value of such studies. How many of us have such cancer detection examinations? Nevertheless, we must continue to encourage these periodic check-ups, and we must all develop the ability to do a thoroughly good pelvic examination.

What should we do when we find a small ovarian enlargement? When this adnexal mass is firm, stony hard, and not cystic, it should be inspected at laparotomy. When it is over 5 centimeters in diameter, regardless of its nature, surgery should be advised. When it is cystic and less than 5 centimeters in diameter, the frequent occurrence of follicular retention cysts, congestion, and edema of the ovary make one continue observation for several weeks. If the mass persists for six weeks, or if it appears to grow at any time, surgery is the preferable method of treatment.

Any pelvic tumor should be considered to be malignant until that diagnosis is ruled out by careful microscopic study. We all recognize that a symptomless fibroid tumor which causes only slight enlargement and distortion of the uterus should be left alone. Yet how tragic, if this so-called fibroid is in truth an ovarian tumor. Our diagnosis of any tumor must be certain before we can advise observation without operation. This calls for frequent thorough pelvic studies.

The symptom of irregular vaginal bleeding, especially postmenopausal bleeding, is always of significance. This symptom demands an immediate examination. In the absence of findings, a thorough endometrial curettage should be performed. Although uterine carcinoma is found in 60 per cent of the patients presenting irregular bleeding, this symptom also may be associated with an ovarian tumor. A careful pelvic examination is always essential.

Although prolapse of the uterus with its accompanying vaginal relaxation usually is due to weakness of musculo-fibrous supports, a pelvic tumor mass, by the pressure it exerts, may be the exciting agent in producing this condition. All patients with prolapse should be examined, to rule out an associated ovarian tumor. Likewise hemorrhoids may be produced by the congestion and pressure of a pelvic tumor mass.

The removal of normal ovaries at the time of hysterectomy or laparotomy, when the patient is past the menopause, is a simple and effective prophylactic measure; but this procedure is debatable in the patient who is still menstruating, even though she be past 40 years of age. Ovarian function is certainly a boon toward good living and it is best not to remove normal ovaries while menstrual function persists.

The patient who has psychosomatic complaints, the neurotic, is always in danger of possessing an undiagnosed cancer. Her cancer-phobia plus her many symptoms referable to all organs causes great distress to her and to her physician. Nevertheless, the physician must keep in mind the possibility of organic disease and repeated abdomino-pelvic examinations have to be made in order to rule out such a development.

At the present time there is no magic formula for the early diagnosis of ovarian cancer. Since the symptoms are so meager and so late in appearance we shall continue to see our patients when it is too late. X-ray examination involving soft-tissue analysis, pneumoperitoneal study, or hysterosalpingography have not been the answer. Culdoscopic visualization of the pelvis is still in its infancy. The first early ovarian cancer diagnosed primarily by culdoscopy has yet to be reported.

When the statistics of 1952 are analyzed we shall find that the mortality of ovarian cancer is still 70 to 80 per cent. Our method of attack should be: 1) to be aware of this silent killer in the abdomen, 2) to consider the possibility of ovarian cancer in every woman over 40, 3) to continue to preach and practice repeated pelvic examinations, 4) to pay close attention to minor symptoms, and 5) to continue to search for new diagnostic methods. Let us hope that the next twenty years will have a better record than the past.

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GERIATRIC ANESTHESIA

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Due to the increase in the mean span of life during the past fifty years, anesthesia and surgery today are complicated by an additional factor, namely, senility with all its debilitating diseases.

In a survey of the literature concerning anesthesia and surgery in patients of the older age group, one is impressed by the fact that the mortality and morbidity rate is only slightly increased above that of younger individuals.

At the present time the average life expectancy of the male is 64.5 years and of the female 69.8 years. With this increase in longevity, diseases peculiar to the aged are more prevalent. Therefore, the number of aged persons coming to surgery is increasing yearly and it behooves us as anesthesiologists to see that these patients are given optimal anesthetic care before, during and after operation, if our morbidity and mortality rates are to be kept to a minimum.

Those who have written on the subject have stressed the importance of adequate preoperative preparation, the careful selection of the anesthesiologist, the choice of anesthetic agent, and the need for the application of sound surgical judgment and gentleness in the handling of tissues. It is emphasized that the surgeon should always avail himself of the services of an expert anesthesiologist.

With the gradual prolongation of the mean span of life it seems fitting at this time for the anesthesiologist, surgeon and internist to give more consideration to the problems of surgery and anesthesia in the aged.

Changes occurring in the aged

The anatomic changes occurring in old age are largely responsible for the difficulties involved in their surgery, anesthesia and management. External changes are more apparent than are internal ones; however, both are manifestations of a prolonged process of deterioration.

The general appearance of the aged has been ably described by Freeman (1) whose description, in part, shall be used.

The most visible manifestation of ageing is in the skin. Evidence of generalized wasting is shown particularly in the skin by increased pigmentation of the exposed parts, decrease of water content with consequent dryness, degeneration of sweat glands, loss of elasticity, and a decrease in its regenerative capacity.

There is brittleness of the nails, and loss of teeth and hair. Depletion of the fat deposits of the face and axillary regions, atrophy of the muscles and fatty degeneration may occur, depending upon the use to which the structures have been accustomed.

The principal change seen in the bones is one of atrophy or osteoporosis. The

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bones become less pliant due to loss of organic material, a condition thought to be due to 1) circulatory deficiency, and 2) loss of calcium and phosphorus. This results from inadequate utilization of ingested calcium, which occurs as a consequence of the lowered gastric acidity and hepatic and pancreatic insufficiency.

The intervertebral discs are calcified and thinned out; in each, the nucleus pulposus loses water and shrinks. Arthritic changes are common and fusion of the vertebrae may result. The capsular ligament of the joints is hardened. The synovial sacs become stiff and hard. Fusion of the entire sternum results in a rigid thorax, impairing pulmonary ventilation. This fusion and hardening of tissues brings about a generalized tendency toward fixation and inelasticity.

The internal organs reveal the characteristic picture of loss of parenchymal tissue. A consideration of the cardiovascular system is of primary importance. In principle, physiologic changes occurring in the heart are primarily due to dehydration, loss of ability for cellular replacement and vascular degeneration (2).

Hypertrophy of the heart is present as a result of a disease process, *i.e.*, hypertension. The hypertrophied heart shows brown atrophy of the muscle and is usually indicative of cardiac strain (3). The myocardium is streaked with fibrosis. Particularly, in old hearts there is some degree of coronary and valvular sclerosis. The blood vessels show evidence of hyperplasia, atheromatous calcification and loss of elastic tissue.

As a result of these changes the blood pressure is elevated. This is of no importance unless the diastolic pressure is elevated (normally, the diastolic pressure tends to fall with age). The pulse rate is usually slower, due to a decrease in sensitivity of the heart to vasomotor influences and a reduction of the basal metabolism. The aged-heart rate shows less responsiveness to extrinsic causes, it accelerates less in response to atropine and slows less in response to carotid sinus pressure (4). Irregularities are frequently noted, especially premature contraction. Extrasystoles are of no significance, if infrequent; but if they are numerous, tend to become exaggerated by exercise, and originate from multiple foci in the ventricle, they usually indicate an irritable myocardium caused by local ischemia, on a valvular basis. Auricular premature beats are significant as precursors of auricular fibrillation; when coupled with a ventricular tachycardia they are tolerated poorly by the aged. The presence of paroxysmal ventricular tachycardia is almost invariably evidence of serious heart disease, usually severe coronary disease. The occurrence of ventricular tachycardia under anesthesia requires emergency treatment consisting of intravenous administration of quinidine diluted in saline solution, morphine or procaine.

The lung fields are reduced approximately 25 per cent, as a result of atrophy; and in about one third of the aged, the lungs will show emphysematous changes. Outwardly the most prominent sign of emphysema is a barrel-shaped chest which assumes a rigid inspiratory position and is associated with atrophy and fatigue of the respiratory muscles. The conspicuous effects are deficient ventilation of the lungs due to impairment of the bellows action of the chest wall, and failure of the lungs to recoil during expiration, because of diminished elasticity. Stagnant gas accumulates in the dilated air sacs. This, together with the reduction of the

alveolar surfaces and the diminished permeability of the alveolar capillary wall, interferes with proper oxygenation of the blood; thus, the nutrition of all the body may suffer because of hypoxia. Dyspnea and tachypnea are the most common symptoms and are the mechanisms whereby ventilation of the lungs is maintained (5).

The gastrointestinal system shows evidence of atrophy of the mucosa and wasting of the muscle layers. Motility and secretions are diminished. Achlorhydria is frequently present. Proper utilization of the organic elements of the food intake is retarded. The incidence of pernicious anemia increases with age. Improper diets, with an inadequancy of vitamins, fats, carbohydrates and proteins are a common occurrence.

The liver, spleen and pancreas are smaller, firmer and undergo either fibrous or fatty changes. The liver shows some decrease in concentration of vitamin C. The incidence of gallstones increases, but the gallbladder empties normally, if free from disease.

The kidneys show increased connective tissue between the apices of the pyramids and a decreased number of glomeruli. Renal deficiency is a frequent accompaniment of old age. The urea clearance test indicates that the reserve capacity of the kidneys is reduced. The bladder wall is atrophic and cystitis is frequently present. Prostatic hypertrophy results in a retention of urinary products.

Blood chemistry frequently reveals decided changes from normal. The red blood cell count and hemoglobin values are reduced, although the number and character of the leucocytes are unchanged. The concentrations of cholesterol and chloride are frequently decreased, and that of nonprotein nitrogen is increased. The blood volume slightly decreased.

Mental changes are frequent in the aged, as a result of cerebral sclerosis. There is impairment of memory and of attentive ability. Perversion of habits may also occur, and changing the sleeping habits from night to day is common. The emotions are extremely labile.

Preoperative preparation

It immediately becomes apparent, after this brief description of the aged, that proper consideration of the patient's general condition is necessary. In the preparation of the patient for surgery it is the reversible changes with which we must concern ourselves and not the irreversible entities. One must be aware of the existence of such conditions as arteriosclerosis, hypertension, valvular, congenital or coronary heart disease, pulmonary fibrosis, emphysema, bronchiectasis, and chronic liver and kidney disease. These conditions will affect us in the selection of our anesthetic agent and management during surgery.

Reversible pathologic states are secondary anemia, hypoproteinemia, dehydration, diabetes, obesity, hypothyroidism, decreased cardiac and renal reserves, bronchitis, oral sepsis, and the "chronic shock state" (a syndrome manifested by weight loss, decreased blood volume, and a decreased level of blood protein and interstitial fluid, as in Addison's disease). These conditions will respond to judicious therapy and they demand our attention in the properative period.

Dehydration results from insufficient fluid intake, diarrhea and vomiting. With fluid loss, salt depletion occurs and the clinical manifestations are those of water and salt deficiency. This combined fluid and salt depletion will result in thirst, dry tongue, dry skin, and a decreased output of urine of high specific gravity. There will be hemoconcentration, and the plasma protein concentration will rise. The increased blood viscosity which occurs in dehydration tends to increase the incidence of venous thrombosis, when combined with venous stasis.

Restoration of the fluid and electrolyte balance before surgery is desirable. Hydration with from 3,000 to 4,000 cc. of fluid daily, two to three days before surgery will be sufficient, unless there are abnormal losses from vomiting, sweating or gastric suction catheters. Normally, the urinary excretion of salt is from 5 to 10 Gm. daily. Salt replacement should be adjusted to meet requirements. In the presence of renal impairment, there is salt retention in the interstitial spaces, with resulting edema. When hypoproteinemia is present, the tendency for edema increases. With renal impairment, the electrolyte balance should be restored by the administration of 0.6 molar lactate or Ringer's solution. Adequate fluid replacement is manifested by correction of the hemoconcentration, loss of thirst, return of tissue turgor and the excretion of adequate amounts of urine.

The restoration of the blood volume and the correction of anemia are essential in the preoperative preparation of the aged for surgery. Anemic patients tolerate anesthesia and surgery poorly and are prone to lapse into a state of shock. Correction of the anemia by blood transfusion will relieve the heart of a notable burden produced by inadequate oxygenation, replace the normal oxygen-carrying capacity of the blood cells of the blood, and restore minor protein deficiencies. It is recommended that 500 cc. of whole blood be given preoperatively for every 7-point deficit in the hemoglobin under 70 per cent.

Protein deficits should be restored as rapidly as possible before surgery. Protein restoration protects the aged against edema, and increases the resistance to infection. Protein replenishment is particularly desirable when gastrointestinal surgery is contemplated. With hypoproteinemia the intestines are swollen, distended and edematous. Normally, 1 Gm. of protein for each kilogram of body weight is required daily. Postoperatively, in the presence of infection, trauma and fever, the maintenance of a normal nitrogen balance may require 2 to 3 Gm. per kilogram of body weight to replace that which is lost. Protein therapy preferably should be by the oral route. If this is inadequate, then the administration of plasma and amino-acids intravenously is necessary to correct the deficiency. The amount to be administered should be adjusted to meet the requirements of the patient. Amino-acid preparations usually are prepared in a 5 per cent solution with 5 per cent glucose and the pH adjusted to 6.5, so that a liter of the solution will contain 50 Gm. of amino acids, 50 Gm. of glucose and 5 Gm. of salt.

Vitamin deficiencies frequently occur and should be suspected in the elderly undernourished patient. Vitamin A is essential for the maintenance of normal liver function and should be given in the presence of hepatic damage. Thiamine is important in the metabolism of carbohydrates; if decreased, the administration of glucose postoperatively will deplete the reserves. Vitamin C is essential for wound healing. A vitamin K deficiency may be suspected in the jaundiced

patient who shows an increased bleeding time. The administration of 1 Gm. of ascorbic acid, 30 mg. of thiamine, 100 mg. of niacin and 5 mg. of riboflavin for several days prior to surgery will adequately correct a major vitamin deficiency.

The elderly uncontrolled diabetic patient withstands surgery and anesthesia poorly. A superimposed ether acidosis in the presence of a subclinical acidosis will increase the postoperative morbidity and mortality. Insulin and glucose should be adjusted to meet the patient's requirements. When glucose is administered during surgery it should always be covered by insulin.

Heart disease per se does not contraindicate surgery in the aged nor mitigate the chances for a smooth postoperative recovery. The presence of a decreased cardiac reserve calls for the administration of the digitalis glycosides and quinidine. The elderly cardiac patient who requires a back support while resting should not be deprived of it upon being transported to the operating room during induction of anesthesia.

Urinary retention as a result of prostatic obstruction frequently occurs in the aged. Concomitant with retention, there is frequently infection. Preoperative treatment should be instituted by means of a continuous catheter drainage, fluids and antibiotic therapy.

The possibility of a pre-existing respiratory infection should be carefully evaluated and prophylactic treatment should be instituted with one of the antibiotics. Preoperative breathing exercises will orient the patient as to the correct procedure for utilizing all the muscles of respiration and decrease the incidence of postoperative respiratory complications.

The oral hygiene of the patient should be carefully supervised. The preoperative use of oral antiseptics should be encouraged.

Last, but not least is the importance of encouraging patients to follow their daily normal practices in the use of tobacco and alcohol, as the withdrawal of these after a lifetime usage will more seriously affect them mentally and physically that the contemplated surgical procedure.

Surgical procedure and medication

From the standpoint of surgical treatment, Rankin and Johnston (5) state that good judgment, speed and gentleness compose the essential triad for surgical success in the aged patient. They state that speed and gentleness tend to avoid shock and minimize the depth and duration of anesthesia, all of which play an important part in the immediate postoperative recovery.

The choice of the operative procedure is a matter of individual judgment, based upon the surgeon's experience. The general status of the patient frequently demands conservatism with a minimum procedure, affording the maximum of surgical benefit commensurate with the preoperative evaluation. It may frequently be necessary for the surgeon to perform a serious operation in multiple stages, in order to decrease the time factor and keep the morbidity and mortality at a minimum.

A factor which is of great importance, but lightly considered by the anesthesiologist and surgeon, is the patient's comfort on the operating table. Be-

cause of their infirmities, mental laxness and fusion of bones, it is difficult for old people to relax comfortably for any length of time. Soft parts and joints should be protected. Extreme positions liable to cause pressure over joints should be avoided. Gentleness and constant encouragement of the geriatric patient is the essence of perfection.

Careful hemostasis should be obtained at the time of surgery. There should be enough relaxation for the surgeon to secure closure of the peritoneum. Mass ligation is to be avoided, since it will produce an avascular area which may become necrotic and serve as a source of infection.

The problem of premedication must be seriously considered. A constant observation in the aged is lowered metabolism and mental depression. The use of large doses of morphine is inadvisable, as this drug has a tendency to produce profound respiratory depression which will interfere with the administration of the anesthetic, and may lead to serious, if not fatal, postoperative complications. The dose of morphine should never exceed $\frac{1}{8}$ grain.

The barbiturates, in particular, are poorly tolerated by the aged, and frequently may produce alarming symptoms before and during operation. The injudicious use of barbiturates tends to result in pronounced respiratory and circulatory depression. Some patients who are particularly susceptible to barbiturates fall into a deep sleep and are difficult to arouse. This depressed state may persist into the postoperative period and may be the predisposing factor to a pulmonary complication or a cardiac collapse. It is advisable not to use barbiturates, but this cannot be an absolute dictum. The elderly patient who is to receive a local, regional block or spinal anesthesia should receive a small dose of a barbiturate, as it is well established that barbiturates elevate the minimum lethal dose of local anesthetic drug. Morphine should be entirely eliminated in these patients. If an opiate must be given, Demerol hydrochloride has been found to be tolerated by the aged patient without serious sequelae. The barbiturate of choice should be short-acting, evanescent, and exhibit few side reactions. Vinbarbital sodium, in a dose of $1\frac{1}{2}$ grains, has been found to meet these requirements.

The belladonna drugs are advantageous in the preoperative preparation of the elderly patient for surgery. Secretions are stimulated following the administration of most inhalation anesthetics. The presence of excessive secretion in the tracheo-bronchial tree impedes the transfer of oxygen and inhalation anesthesia. The belladonna drugs depress this secretion and furthermore, help to prevent the occurrence of vagal reflexes.

Because of its euphoric properties, scopolamine should be used with caution in the aged; moreover, it may have a decidedly psycho-depressing effect when combined with an opiate. Atropine increases the heart rate and the minute volume of circulation, resulting in increased oxygen consumption. The coronaries may not be able to dilate, if they are atherosclerotic and inelastic, in order to compensate for this increased oxygen demand, so that the myocardium may become hypoxic. Atropine is the agent of choice when given in small doses never exceeding $\frac{1}{300}$ of a grain.

The premedicant drugs should be given approximately one to one and a half

hours before surgery. It is good clinical judgment to be on the alert for increased susceptibility following the administration of these drugs, as manifested by severe hypotension (barbiturate), Cheyne-Stokes type of respiration (opiates), anoxia, psychic effects, flushing, perioral pallor, dry mucous membranes, fever and tachycardia (opiates, barbiturates and belladonna drugs). If such reactions occur, surgery should be deferred.

Anesthesia

In the selection of the anesthetic agent, it is important to decide upon agents and techniques with which one is most familiar. Almost any agent is satisfactory if used with caution. Geriatric patients are easily quieted with sedatives, readily anesthetized and prone to be overdosed. Thus conservatism is all important.

The anesthesiologist has a wide selection of anesthetic agents from which to choose. These include the following:

1. *Diethyl ether.* Ether has been accepted as one of the safest anesthetics in the hands of the inexperienced, but its postoperative morbidity and deleterious effects upon the kidneys and liver make its selection by the anesthesiologist of secondary value for the aged. Postoperative vomiting and nausea frequently occur after its use. With deep anesthesia the intestines are paralyzed and the small intestines become dilated and atonic. This is due to sympathetic stimulation and paralysis of the muscles of the intestinal walls. In abdominal surgery the intestines may become so markedly dilated as to impede the surgeon, making it necessary for him to use abdominal packs. Closure of the wound may be difficult, with tearing of the peritoneum and inadequate approximation of the layers.

Kidney function is depressed and in the presence of kidney disease a marked reduction of kidney function occurs. The plasma bicarbonate level is decreased and the pH of the blood reduced, so that acidosis occurs and ketone bodies may be excreted in the urine.

2. *Chloroform.* Waters (6) and his group have used chloroform without deleterious effects in the aged. Nevertheless, in spite of this favorable report, chloroform is not a desirable agent for the geriatric patient. Chloroform is a markedly depressant drug and primarily shows its effects upon the respiratory and cardiovascular centers.

Depression of the respiratory center occurs, with decreased pulmonary ventilation. Hypoxia invariably accompanies its administration, and this is accentuated by the reduced oxygen-carrying capacity of the blood, as a result of its direct action upon the erythrocytes.

The blood pressure falls as a result of depression of the vasomotor centers, the myocardium and decreased cardiac output.

Kidney function is depressed and damage to the cells of the tubules occurs with the passing of casts and albumin.

3. *Nitrous oxide.* Nitrous oxide-oxygen is a safe and useful agent in the geriatric patient. Nitrous oxide is a weak anesthetic and clinical experience has shown that effective anesthesia may be maintained, with concentrations of 30 per cent or more of oxygen. If there is no hypoxia, nitrous oxide is a nontoxic agent. It is

non-irritating and its inhalation does not produce respiratory distress. Any feeling of suffocation that may occur is due to faulty technique in administration. Its effects upon the heart and blood pressure are nil, if hypoxia has not supervened. However, it should be used with caution in patients with cardiovascular disease and only by an experienced anesthesiologist. A combination of Pentothal Sodium intravenously for induction, followed by nitrous oxide and oxygen in high concentration, affords adequate protection and anesthesia for the severe cardiac cases.

4. *Ethylene.* Ethylene-oxygen may be placed in the same category as nitrous oxide-oxygen, as it has no significant effect upon the organs of the body, unless oxygen want has been present. It may be used with impunity for a wide variety of minor surgical procedures. Ethylene is non-irritating, but salivary and mucous secretions are increased. Muscular relaxation is slightly better than with nitrous oxide. Headache frequently occurs following its administration. Postoperative nausea and vomiting are seen more frequently than with nitrous oxide. In contradistinction to nitrous oxide, ethylene is a highly explosive agent.

5. *Cyclopropane.* Cyclopropane has been condemned unmercifully by surgeons, internists and anesthesiologists. It is a potent and useful agent for the aged. The geriatric patient may be anesthetized rapidly, relaxation is good, a high oxygen concentration may be maintained and recovery is rapid.

Cyclopropane does not disturb hepatic or renal function or alter carbohydrate metabolism appreciably. Even though there is a 10 to 30 per cent increase in the concentration of blood sugar, acidosis is not accentuated and its use in the diabetic patient is indicated.

Cyclopropane has no stimulatory effect upon respiration. Therefore, the use of premedication respiratory depressants should be decreased. The depressant action of cyclopropane renders it a particularly desirable agent in cases in which the movements of the lungs and diaphragm are to be minimized.

This agent, nevertheless, has a profound action upon the cardiovascular system. Peripheral vasodilation occurs, with increased capillary oozing. This is confined to the skin and subcutaneous tissues. The cardiac musculature is particularly susceptible to the stimulatory effect of epinephrine when cyclopropane is present. Cardiac irregularities may occur, but if the anesthesiologist is on the alert, this condition may be diagnosed before it becomes too serious. Bradycardia and arrhythmia are signs of impending danger and are indications for reducing the cyclopropane concentration. Increasing the oxygen concentration and pulmonary ventilation by supplementing the breathing will rectify the condition. Cyclopropane possesses a vagotonic effect and, because of this, coronary constriction may occur, rendering the coronary patient more susceptible to an occlusion on the table. Cyclopropane should not be used in the patient giving a history of coronary infarction.

The blood pressure is also occasionally increased; this is thought to be due to a direct effect on the central or peripheral vasomotor mechanism, or to a depressed respiration with hypercapnia. Again this condition may be remedied and the blood pressure stabilized if pulmonary ventilation is adequately maintained

by supplemental respiration. Post-cyclopropane hypotension, furthermore, may be avoided by a carefully administered anesthetic with the anesthesiologist's attention focused constantly upon pulmonary ventilation and the maintenance of an even plane of anesthesia.

Muscular relaxation is variable, but good muscular relaxation may be produced if the anesthesiologist strives to obtain a high degree of body saturation and the avoidance of a high cerebral concentration (with consequent severe respiratory depression) during induction of anesthesia. If adequate muscular relaxation cannot be obtained with cyclopropane without jeopardizing the patient, it is better to use a curarizing drug of short duration, *i.e.*, Syncurine.

The advantages of cyclopropane anesthesia far outweigh the disadvantages in its applicability for the geriatric patient. The administration of this anesthetic calls for a high degree of skill, and it is necessary that the anesthesiologist be cognizant of its potential dangers and that he give his undivided attention to the patient before, during and after anesthesia.

6. *Rectal basal anesthetics.* Rectal anesthetics such as tribromethanol (Avertin), Evipal and Pentothal should be avoided. Avertin is particularly dangerous for the patient who is suspected of having a liver or kidney complication. Basal anesthetics cause profound and generalized depressant effects in the postoperative period, thereby increasing the possibilities for a postoperative respiratory or cardiovascular collapse. Geriatric patients should be awake immediately after surgery if morbidity is to be kept to a minimum.

7. *Intravenous agents.* Intravenous anesthetics such as Pentothal Sodium (1.0 to 2.5 per cent), Evipal Sodium (2.5 per cent) and Surital Sodium (2.5 per cent) may be used in short minor surgical procedures without the addition of other agents, except oxygen. Respiratory depression must be avoided. When used in combination with nitrous oxide 50 per cent and oxygen 50 per cent, they become valuable agents for the debilitated geriatric patient.

Pentothal Sodium should be given cautiously, by the intermittent technique, with the initial dose never more than 2 to 3 cc. of a 2.5 per cent solution. Following this initial test dose the anesthesiologist should determine the degree of depression and analgesia present before giving additional amounts. Sixty seconds by the clock should elapse before injection of more Pentothal. The more one becomes experienced with this drug, the more he realizes how hazardous it is to justify the use of a fixed concentration and the giving of specific amounts.

The respirations are the anesthesiologist's most valuable guide to depth of anesthesia. Initially the depth of respirations is increased, and this is followed by a decrease in the depth and also in the rate of respiration. The administration of more Sodium Pentothal at this time will cause a marked decrease in depth or may completely abolish the respiration. The depth of respiration may serve as a guide to the degree of anesthesia and an increase in the depth rather than in the rate of respiration is an indication for lightening of anesthesia.

The blood pressure may fall following the injection of Pentothal Sodium, with a slight increase of the pulse rate. This depression of blood pressure is not marked if the administration has been careful and, therefore, the drug may safely be given to the hypertensive patient.

It has been stated that Pentothal Sodium increases the sensitivity of the larynx, resulting in an adductor spasm of the vocal cords or laryngospasm. The occurrence of laryngospasm in the hypertensive geriatric patient may be serious and can be avoided. Careful administration of the agent, with adequate premedication consisting of atropine, will usually prevent this complication.

As stated previously, the geriatric patient should be awake at the conclusion of an operation. The anesthesiologist should gauge his administration, so that as little anesthetic as possible is given near the end of the operation.

8. *Local infiltration.* Local infiltration is the method of choice, if at all practical. It is necessary that the patients receive adequate sedation before operation, with the barbiturates. The greatest objection to the use of local infiltration without supplemental anesthesia is that geriatric patients become very restless after a short period of time. It is difficult for them to understand and, above all, to relax. Local infiltration is an excellent method when combined with an intravenous drip of Pentothal, 0.1 per cent.

9. *Regional-block anesthesia.* Regional-block meets the requirements for perfect anesthesia, but expertness in administration is essential. The same objections are applicable, as in the case of local infiltration. Furthermore, it is time consuming to administer and if perchance the anesthetic should wear off before the operation is completed, it becomes extremely difficult to anesthetize the patient with an inhalation anesthetic without exasperating the surgeon.

Operations performed under regional block procedures progress exceptionally well when supplemented by an intravenous drip of 0.1 per cent Pentothal Sodium.

10. *Subarachnoid analgesia.* Subarachnoid or spinal analgesia is particularly desirable for the geriatric patient. The agent of choice should be that with which the anesthesiologist is most familiar, and a successful subarachnoid analgesia involves meticulous attention to the finer details of making the patient comfortable. The maintenance of a normal physiologic balance is the most important consideration of the anesthesiologist for the geriatric patient undergoing surgery with this type of analgesia. Due to the marked inelasticity of the circulatory system, physiologic imbalance, with fall in blood pressure may occur. The maintenance of a normal blood pressure is necessary in old people, for if the blood pressure falls too low, the circulation of the myocardium is interfered with, urinary excretion ceases, tissue anoxia occurs and the vital centers may not get sufficient blood to maintain adequate oxygenation.

Vasoconstrictors should be used with caution, because of their cardiac and cerebral effects. The prophylactic use of vasopressor drugs should be based upon sound clinical judgment. The elderly individual with a low normal pressure who is to receive a low spinal analgesic does not need a vasopressor. The patient with a hypertension in whom a high spinal analgesic is contemplated, should receive a vasopressor at the time the dural tap is made. The prophylactic use of a vasopressor should be conservative and 5 mg. of Vasoxyl has been found adequate. If the pressure begins to fall appreciably, an additional 5 to 10 mg. should be given slowly, intravenously.

The occurrence of respiratory paralysis is infrequent, but its presence demands immediate attention. No patient need die from respiratory paralysis following

a spinal analgesia. Pulmonary ventilation and arterial oxygen concentration may be maintained by manual pressure on the breathing bag.

Furthermore, since the geriatric patient is very susceptible to oxygen lack, it is advisable to administer 100 per cent oxygen in all spinal analgesia cases and it is especially important in the high spinal type.

11. *Continuous spinal anesthesia.* Continuous spinal and caudal anesthesia meets the needs of the anesthesiologist for safety, controllability and duration. Only small doses are recommended for the initial injection, to be repeated as necessary, approximately every thirty minutes, carefully avoiding too high an extension of the agent in the subdural space. The agent may be supplemented with a continous drip of Pentothal Sodium, 0.1 per cent, to acquire the necessary quiescence during long and protracted surgical procedures.

12. *Saddle-block anesthesia.* Saddle-block anesthesia with Pontocaine, 1.75 to 2.5 mg., is advantageous for perineal and anorectal surgery. Saddle-block analgesia with minimal amounts of the anesthetic agent is particularly desirable for the aged patient about to undergo a transurethral prostatic resection. With saddle-block analgesia, overdistention of the bladder will elicit discomfort.

Extravasation, furthermore, is recognized by the acute epigastric pain which occurs and the board-like rigidity of the abdomen. It must be emphasized that these aged patients will experience cramping in the legs while in the lithotomy position and complain vigorously if they are not made comfortable.

13. *Curariform drugs.* Curare, or Syncurine, has proved a valuable adjuvant. It provides the necessary relaxation under a gas anesthetic, so that the most difficult upper abdominal exploration may be carried out with ease and safety. Curare, or Syncurine, is especially advantageous in the elderly patient, as a lighter plane of surgical anesthesia may be maintained. This allows for speedy recovery from the anesthetic, and enables the senile patient to become ambulatory sooner. Syncurine is efficacious, there is less tendency to respiratory depression and the duration of relaxation is approximately twenty minutes. It also has the advantage of not causing histamine-like reactions, such as bronchospasm and fall in blood pressure. Syncurine may, furthermore, be used with ether anesthesia without producing a severe curariform reaction.

Syncurine and curare should be administered cautiously and divided into small doses, allowing ample time for the generalized distribution of the drug and noting its effects before giving additional amounts.

14. *Refrigeration.* Refrigeration anesthesia is an excellent choice for amputation of extremities in aged patients. The only disadvantage is that it is time-consuming and frequently messy. Nevertheless, if properly executed, there is a minimal degree of physiologic imbalance, with a maximum rate of tissue healing and resumption of normal activity.

General remarks. In administering anesthesia to the aged, the skill and judgment of the anesthesiologist is of great importance. A trained anesthesiologist is of valuable assistance to the surgeon in the treatment of these patients. The anesthesiologist should pay particular attention to maintaining the depth of anesthesia in as light a plane as possible, consistent with efficiency and with

competent surgery. He should prevent shock by its early recognition and treatment with blood and plasma, as well as by drugs. Blood lost during surgery should be immediately replaced by accurate measurement—cc. for cc. Overloading the patient during the operation may precipitate an acute circulatory collapse.

Constant observation is directed to anoxia, with its concomitant dangers, and to its prevention by administration of adequate quantities of oxygen and the maintenance of a patent airway. The anesthesiologist should not hesitate to insert an endotracheal tube whenever he is in doubt about the patency of the airway in its entire length.

Postoperative care

In the immediate postoperative period the anesthetist should prevent atelectasis and other pulmonary complications by tracheobronchial cleansing immediately after operation. The insertion of a catheter under direct vision immediately after surgery will frequently obviate the necessity of a bronchoscopic aspiration. The aged patient who is suffering from emphysema, bronchiectasis and asthma is greatly helped by mixtures of helium with oxygen.

The unconscious geriatric patient's airway should be carefully checked frequently by the nurse in whose charge he is left. The head should be turned to one side to prevent a backward gravitation of the tongue. He will sometimes be breathing with great difficulty, due to the extreme relaxation which frequently persists into the postanesthetic period if he has been too depressed during anesthesia. Such fatiguing efforts drain the patient's cardiac reserve while he is suffering from oxygen want and carbon dioxide excess. The administration of oxygen by nasal catheter (6 to 8 liters per minute) is always indicated.

The administration of Coramine, 3 cc. every half hour for six doses, has been of value for the maintenance of muscle tonus and improving the coronary circulation in the postoperative period.

Sedation and stimulation should be kept to a minimum. The injudicious use of the opiates for pain relief and barbiturates for amnesia, is to be condemned, as their indiscriminate use is fraught with danger. In the geriatric patient who has been given too much sedative a respiratory depression is prone to develop, resulting in hypoxia and a predisposition to an acute, coronary attack. Oversedation, furthermore, depresses the mental functions to such a degree that patients do not respond and cooperate. It has been found that the administration of routinely ordered opiates has frequently resulted in severe respiratory and circulatory depression, from which the patient expired.

The geriatric patient should be made ambulatory within twenty-four to forty-eight hours after surgery, consistent with good judgment. In the immediate postoperative period these patients should be encouraged to change their position frequently. This will help to prevent the development of postoperative respiratory and circulatory complications.

The administration of intravenous procaine, 0.1 per cent, has been found efficacious for the control of pain in the immediate postoperative period. In cases of upper abdominal surgery or cases in which intravenous fluid administra-

tion is limited, intercostal nerve block (from thoracic 6 to 12) with 1 per cent procaine has been found efficacious in relieving pain.

The indiscriminate use of vasopressor agents to maintain blood pressure in the immediate postoperative period, unless definitely indicated, is fraught with danger. Hypotension resulting from blood loss, surgical trauma or anesthetic depression should be treated by warmth, oxygenation and blood, as required. The addition of Vasoxyl, 5 cc. added to 500 cc. of 5 per cent glucose, has frequently restored a waning blood pressure to normal levels.

In the postoperative period, fluid should be administered slowly so that the weakened heart is not overtaxed by a sudden influx.

COMMENT

It has been stated by surgeon and by anesthesiologist that the duration of anesthesia and of surgery is of no significance, with our modern methods of anesthesia and competent anesthesiologists. The duration of anesthesia directly effects the morbidity and mortality in the geriatric patient. The mortality is increased by approximately 25 per cent if the operation is over one hour in duration and this figure increases progressively as the duration increases.

The maximum operating time in the patient who is a good surgical and anesthetic risk should never exceed sixty minutes, if the morbidity and mortality is to be kept low. Patients who show signs of failure of the circulatory system, such as cyanosis, dyspnea on slight exertion, enlarged liver, edema and congestive rales in the lung bases, are poor anesthetic risks. The only surgical procedure contemplated in these patients should be that of a life-saving measure, with the operating time reduced to a minimum.

The depth of anesthesia is likewise important. If it is necessary to maintain a geriatric patient in deep surgical anesthesia for more than thirty minutes, the morbidity and mortality will be increased.

In elderly patients, the chances of survival following surgery and anesthesia are good. This necessitates the cooperation of the surgeon, internist and anesthesiologist. The clinician who defers surgery of a corrective nature and allows the condition to progress until an emergency surgical procedure is required, is not giving that patient the most favorable chance for survival consistent with good medical care.

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DIFFERENTIAL DIAGNOSIS OF CEREBRAL VASCULAR DISEASE AND INTRACRANIAL NEOPLASM

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Advances in the treatment of both cerebral vascular disease and intracranial neoplasm make early differentiation of these conditions increasingly important. In the past many have assumed that there was little reason to confuse the diagnosis of cerebral vascular disease with its traditionally sudden onset (strokes), and that of brain tumor with its equally traditional gradual progression of symptoms, findings and signs of increased intracranial pressure. However, experience, especially with patients over 50, soon teaches that often this differentiation is very difficult. It is my purpose to review the reasons for this difficulty, to point out the diagnostic pitfalls, and to emphasize the special procedures which may be of aid.

First it may be pointed out that cerebral vascular disease is not always sudden in its onset. Even hemorrhage may be slowly progressive in onset. In such cases a slowly developing subcortical hematoma gives the mechanical effects of a space-occupying lesion and in air studies or angiograms is mistaken for a neoplasm.

Case 1. E. O., a 49-year-old man, was seen three weeks after the development of left hemiparesis. Three years before, he had had ataxia and dysarthria for a few days after a febrile illness. A year before, he had had an attack of unconsciousness lasting ten minutes.

The patient was stuporous and responded only briefly. There was moderate weakness of the left extremities and a left Babinski response. The spinal fluid was bloody and xanthochromic. A percutaneous right carotid angiogram showed downward displacement of the middle cerebral artery and displacement of the anterior cerebral artery across the midline. The preoperative diagnosis was a large subcortical parietal neoplasm with hemorrhage into the lateral ventricle.

Craniotomy revealed a very large subcortical hematoma of the right parietal lobe, which had destroyed the medial part of the cerebral hemisphere and extended into the lateral ventricle. The hematoma was removed and the wound closed. The patient improved temporarily but died a week later. Necropsy revealed no fresh intracranial hemorrhage. There was severe diffuse bronchopneumonia and generalized arteriosclerosis, with particular involvement of the aorta and cerebral vessels. Detailed microscopic examination of the brain failed to show any evidence of neoplastic tissue.

Comment: The angiographic findings and the history of previous episodes of cerebral disturbance suggested that this patient had a slowly growing subcortical parietal tumor with hemorrhage into the lateral ventricle. The mechanical effects of a tumor were simulated by the large hematoma.

Vasospasm and thrombosis may be repetitive. At first only small vessels may be involved, with vague symptomatology, but after repeated attacks the involvement of larger vessels produces progression of symptoms and neurologic findings. Either subcortical hematoma or swelling of the brain associated with infarction

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and softening may produce evidence of increased intracranial pressure, even papillo-edema. Such localized cerebral swelling may displace the ventricular system so that air studies indicate the presence of a neoplasm, or blood vessels may be displaced so that angiograms suggest a space-occupying lesion. Aneurysms ordinarily produce subarachnoid hemorrhage of sudden onset but they may bleed into the cerebral tissue, producing intracerebral hematomas that suggest tumor. An occasional thrombosis in an aneurysm may progress into the parent vessel, occluding it and producing infarction with swelling that simulates tumor.

Case 2. Mrs. M. V., a 38-year-old woman, was admitted to the hospital with complete right hemiplegia and aphasia. One month before, she suffered sudden severe headache and lost consciousness for several minutes. Since then, headache had persisted. Recently she had shown mental confusion, and then aphasia and right hemiplegia developed.

Examination revealed bilateral papillo-edema in addition to complete aphasia and right hemiplegia. Percutaneous left carotid angiography was carried out, to evaluate the nature and blood supply of the presumed left cerebral tumor but this revealed a large aneurysm of the left internal carotid artery just proximal to the origin of the middle and anterior cerebral arteries. The middle cerebral vessels were displaced downward and the anterior cerebral vessels to the right of the mid-line, suggesting a mass lesion in the left frontal lobe. The patient was then thought to have an intracerebral hematoma arising from the aneurysm. The spinal fluid was now found to be xanthochromic and left transfrontal craniotomy was carried out for evacuation of the presumed hematoma. This revealed extensive softening of the left cerebral hemisphere but exploration with a cannula failed to reveal any subcortical hematoma. The patient died the next day.

Permission for necropsy could not be obtained but it appeared that the patient initially had slight leaking from the aneurysm. Spontaneous thrombosis in the aneurysm progressed to involve the internal carotid artery and its bifurcation into middle and anterior cerebral arteries. The resultant infarction of the anterior part of the left cerebral hemisphere and the associated cerebral swelling produced papillo-edema and also mechanical displacement of the cerebral vessels.

Comment: This case illustrates the confusion that may arise from the presence of cerebral swelling and also from cerebral aneurysms, in the diagnosis of intracranial tumor.

Intracranial hemorrhage may suddenly occur from abnormal vessels or from erosion of normal vessels in previously silent brain tumors. This hemorrhage may be subcortical, intraventricular, or subarachnoid and in the absence of previous symptomatology may appear to be primary. The persistence of residual symptoms, their later progression and especially the appearance of papillo-edema should suggest neoplasm.

Tumors which have previously been asymptomatic may begin to cause symptoms and produce abnormal findings after trauma to the head. This may give rise to interesting medico-legal problems when there is a question of liability involved, but from the standpoint of the neurosurgeon it usually raises the question of a possible subdural hematoma. The spinal fluid is xanthochromic in a high percentage of cases of subdural hematoma but that is also true of some cases of brain tumor, especially those impinging on a ventricle or located in the posterior fossa. If surgical exploration is carried out and no hematoma is found,

ventriculography should be performed in order to reveal the presence of a neoplasm. As pointed out by Stein (1) angiography is not only diagnostic in cases of chronic subdural hematoma but, if neoplasm is involved, will reveal its presence and often its type.

Epileptiform seizures in adults are often considered to be idiopathic in origin or due to cerebral vascular disease. If there has been a previous injury to the head, the seizures may be thought to be post-traumatic in origin. It is essential to remember that epileptiform seizures are a common initial symptom of cerebral tumor in adults and consequently every adult who begins to have convulsions must be suspected of having an intracranial tumor until it is proven that he does not.

Perhaps the most common pitfall or mistake which the physician should avoid when confronted with the problem of an intracranial lesion is to assume that the diagnosis is apparent and to fail to study the patient thoroughly.

Case 3. Mrs. L. S., a 61-year-old woman, was seen in the office. She had been very nervous for the preceding month. Recurrent dizziness had been noted for six weeks, and headaches (not associated with nausea and vomiting) for two weeks. The patient's relatives stated that she was confused at times and apparently suffered from hallucinations. Hypertension had been present for several years.

Examination revealed a florid obese white woman who was loquacious, jovial and apparently lacked insight. There was mild generalized tremor and incoordination but no other significant neurologic findings. The optic fundi showed marked retinal arteriosclerosis. The patient was thought to have hypertensive encephalopathy and sanitarium care was advised. A month later we were informed that the patient had succumbed after a craniotomy elsewhere, which had revealed an extensive glioblastoma of the right frontal lobe.

Comment: The facies of the patient, her general behavior, and the history of hypertension seemed to make the diagnosis of hypertensive encephalopathy apparent. Obviously, further examination would have revealed the correct diagnosis. Patients in adult life who present evidence of intracranial disturbance that is not acute in nature or related to trauma should not only be thoroughly examined neurologically but should have roentgenograms of the skull and spinal fluid examination; in many cases either cerebral angiography or diagnostic air studies should be carried out. Only by such studies can many cases of intracranial tumor be recognized early enough to be benefited by surgical treatment.

Failure to repeat examinations which previously gave negative or normal findings, sometimes accounts for failure to recognize the presence of a tumor. Because x-ray examination of the skull showed a calcified pineal gland in the midline three months before, it cannot be assumed that the ventricles may not now be displaced. The same is true of previously normal electroencephalograms, angiograms and pneumo-encephalograms. The value, however, of repeated clinical neurologic examinations and especially of ophthalmoscopic examinations cannot be over-emphasized. On many occasions papillo-edema has appeared in patients while under observation or even while undergoing diagnostic study (Case 4).

Unfortunately, none of the available diagnostic procedures or examinations is entirely dependable. A careful history and detailed clinical neurologic examina-

tion are the basis of all neurologic diagnosis but every clinician is aware of the occasional unreliability of a history, and even objective neurologic findings are often misleading or confusing. When neoplasm is present, increased intracranial pressure or circulatory disturbances may give rise to cerebral involvement some distance from the lesion, with consequent false localizing signs. Of the various special procedures used at the present time, air studies (either pneumo-encephalography or ventriculography) are by far the most dependable. However, they may fail for several reasons. If a neoplasm is still small, the ventricles may not be significantly distorted or displaced. As already pointed out, the edema or swelling associated with cerebral thrombosis, especially in its early stages, may cause distortion or displacement of the ventricular system that suggests the presence of a tumor. As Case 1 shows, a subcortical hematoma may also simulate a tumor in air studies but, since the patient often benefits from the surgical removal of a hematoma, this diagnosis is not a serious error. Occasionally the failure of air studies to reveal the presence of a tumor is difficult to explain.

Case 4. F. B., a 56-year-old man was seen because of recurrent headaches for a year, with alteration in personality for six months and marked generalized weakness for six weeks. Speech difficulty had been noted for one week. A month before, he had had a generalized convulsion followed by coma for twenty-four hours, and had been admitted to another hospital. A pneumo-encephalogram and a left carotid angiogram had been carried out. These films were personally reviewed. The angiogram was technically unsatisfactory. The encephalogram showed moderate dilation of the cerebral ventricles without any distortion or displacement. The cerebral subarachnoid spaces were well filled and showed no asymmetry. There was no evidence of a space-occupying intracranial lesion.

Neurologic examination revealed moderate expressive and perceptive aphasia and mild weakness and incoordination of the right upper extremity. The optic fundi showed no evidence of increased intracranial pressure. In view of the pneumo-encephalogram of a month before, the patient was presumed to have a cerebral vascular lesion in the left fronto-temporal region.

Procaine block of the left stellate ganglion the next day did not produce any neurologic improvement. The patient was treated with oral vasodilator drugs but the aphasia and weakness of the right upper extremity grew more marked. Nine days after admission to the hospital papillo-edema was noted. The next day a left carotid angiogram revealed displacement of the anterior cerebral artery across the midline and an area of abnormal vascularity deep in the posterior parietal region.

Left fronto-parietal osteoplastic craniotomy revealed a large subcortical infiltrating glioblastoma involving the posterior temporal and inferior parietal lobes. It was grossly removed except for its most mesial portion, which was very vascular. Following this procedure the patient's asphasia and right hemiparesis was more profound. After the wound had healed he was given a course of high voltage roentgen therapy. He improved for a few weeks but at the time of writing (February 1, 1953) he was again failing.

Comment: The history was strongly suggestive of intracranial neoplasm but the negative results of the air studies seemed to rule that diagnosis out, until papillo-edema appeared. It is difficult to see how the very large glioma found at operation could not have been demonstrated by air studies six weeks before, but such was the case.

Cerebral angiography has become of increasing importance in the diagnosis of intracranial tumors (2). In addition to revealing the presence of a tumor it

often localizes it with great exactitude and by revealing a specific vascular pattern may lead to the correct preoperative diagnosis of its type. The most commonly used material at the present time for injection is Diodrast (sodium iodopyracet). The material is dangerous in elderly or arteriosclerotic patients, as it is irritating to cerebral blood vessels and may produce vasospasm with resultant thrombosis. On the other hand, it does not affect intracranial pressure and consequently angiography does not have the danger of air studies in cases of increased intracranial pressure. Because of the specific danger of Diodrast in the older age group, it is my present practice to use thorotrast (colloidal suspension of thorium dioxide) in patients over 50. It is unlikely that there will be harmful radioactivity from thorotrast stored in the reticulo-endothelial system in the remaining life span of these patients. Since thorotrast may produce granulomas if infiltrated into the soft tissues, percutaneous angiography should not be attempted with it. The carotid vessels should be exposed surgically and the injection of thorotrast made directly into them. With these precautions it is believed that angiography is little more dangerous in elderly patients than in the young.

Radioisotope studies have been of great diagnostic value in some hands, in the diagnosis of brain tumors. These studies are neither dangerous nor uncomfortable and consequently are more desirable than either air studies, which are uncomfortable and at times dangerous, or angiography, which is also uncomfortable and even dangerous although to a lesser degree. Unfortunately, the accuracy of radioisotope studies in both the diagnosis and localization of intracranial tumors has been disappointing. In our hands the percentage of error has been about the same as with electroencephalography, *viz.*, 30 to 40 per cent. However, other workers, especially Davis and his associates (3), have claimed up to 95 per cent accuracy. Further refinements in technique (4) are promising and eventually this method may supplant air studies and angiography.

In the last twenty-five years clinical electroencephalography has become a widely accepted and useful diagnostic procedure. The original hope that it would be safe, painless and reliable has not been borne out. Although it is safe and painless, it is not reliable. Other organic brain lesions, such as those due to cerebral vascular disease, may produce changes in the electroencephalogram similar to those seen in brain tumors, Furthermore, the remote effects that a tumor may produce on other parts of the brain often produce false evidence of localization in the electroencephalogram, or else produce generalized disturbances that do not permit localization. Although some electroencephalographers claim as high as 85 per cent accuracy in localization, the experience of Cuneo, Rand and Sjaardema (5) is more nearly that of my own (6). They were able to localize sharply 19 (47.5 per cent) of 40 verified brain tumors and to lateralize correctly another 10 per cent.

Therefore at the present time, although electroencephalography and radioisotope studies have some negative value, in that when the results are normal or fail to show evidence of a localized lesion the likelihood of neoplasm is lessened, the neurologic surgeon has to depend on cerebral angiography or diagnostic

air studies for positive corroboration of the presence of an intracranial neoplasm. These studies, because of their inherent risks and dangers, cannot be made routine in all middle-aged or elderly patients with evidence of organic intracranial disease but must be used in doubtful cases.

SUMMARY

The differential diagnosis of intracranial neoplasm and cerebral vascular disease is difficult, especially in elderly patients. The diffuse character of many gliomas and the vascular changes associated with them may simulate cerebral vascular incidents. On the other hand, subcortical hematomas, or the swelling of the brain associated with cerebral thrombosis, may give the mechanical effects of a tumor.

The most common sources of error are the acceptance of an apparent clinical diagnosis without adequate confirmation, failure to repeat diagnostic studies at intervals, and mistakes in interpretation of special diagnostic procedures.

The middle-aged adult with clinical evidence of organic cerebral disease must not only have a complete history, general physical examination and detailed neurologic examination but should have roentgenograms of his skull and chest. Unless papillo-edema is present, a spinal fluid examination should be made. Electroencephalography and radioisotope studies may be helpful, if these facilities are available. In spite of the risks, either angiography or air studies or both may be necessary to establish the final diagnosis in some cases.

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TREATMENT OF MENTAL DISORDERS IN THE GERIATRIC PATIENT*

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The treatment of mental disorders in the geriatric patient has greater possibilities than is generally recognized. We grant that patients with cortical atrophy, destructive cerebral arteriosclerosis and other untreatable senile brain conditions (Group I) are frequent and bear a poor prognosis. However, if observed over a sufficient period of time, some of these condemned patients show surprising remissions under the standard treatment, which consists of a change of environment, good general care, good food and vitamins.

There is another group of patients (Group II) who look and behave like those with true senile psychosis. They have encountered one of the many types of stress, such as pneumonia, surgery or a severe nervous shock, and have become psychotic. Many of the relatives can then recall the nervous complaints and peculiar behavior of the patients prior to the psychosis. The relatives' reports may be either true or fancied and may be prompted by a variety of forces, usually suggestion. These patients are frequently acutely ill and sometimes die quickly. If they are 60 years old or over, the diagnosis is usually senility or arteriosclerotic psychosis and the standard treatment is given. The stress may or may not have disappeared by this time, but in either event it is not given credit for any part of the illness.

Still another group of patients (Group III) aged 60 or over, in whom the diagnosis unquestionably must be senility or arteriosclerotic psychosis, look and behave as if suffering from schizophrenia or affective psychoses. Except for exhaustion or intercurrent infections they bear a better immediate prognosis than do the patients of Group II. They often have the physical equipment of a much younger person and if their chronologic age could be forgotten the word senile might disappear from the clinical picture. Patients with the same syndrome at ages ranging from 40 to 55 would be treated actively in most clinics today, but in the patients of Group III the chronologic age is the outstanding part of the picture. The pessimistic attitute of physicians, from the general practitioner to the psychiatrist, is transmitted to the relatives. The standard treatment is used and eventually these patients die.

Probably the reason this situation prevails is that our medical books advise the standard treatment and give a poor prognosis in senile psychosis. This is the correct procedure for patients in Group I. However, the elderly people of Group II who have a psychosis after stress, and those in Group III who have

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the physical equipment of a younger person but whose schizophrenic or affective psychosis occurs in the senile age range, frequently respond as well as younger people to indicated medical and supportive treatment, such as insulin therapy and/or electric shock therapy, subsequent psychotherapy, and rehabilitation.

Prior to 1935 we observed that patients 60 years of age or over with a psychosis usually had a bad prognosis and the death rate was too high. Often the autopsy findings in these older people were not sufficient to explain the death. In 1934 and 1935 Sakel (1) reported his experiences with insulin shock therapy in schizophrenia. Cowie, Parsons and Raphael (2) had previously reported the use of insulin in tonic doses to improve the appetites and general physical condition of mental patients. Many others then reported the use of insulin in mental patients, with Cowie's technique. Immediately after Sakel's report we began using his method of insulin therapy in patients with schizophrenia and other types of functional nervous and mental disorders. By 1938 Conwell and Kurth (3) had used Sakel's insulin shock therapy on 4 patients of geriatric age. Three of them improved to social (normal life at home) and 1 to occupational (normal life) levels. We found that insulin shock therapy carried with it definite hazards at any age but there was additional risk in geriatric patients because their insulin tolerance was liable to be very low. We continued to explore the possibilities of insulin therapy in older people. We quickly modified Sakel's technique and often approached and even modified Cowie's method.

The difficulty of controlling metrazol therapy eliminated its use in elderly people. For some time electric shock was controlled by many contraindications. We used it cautiously in the senile psychotics who were in good condition on physical examination but who were being severely deranged by emotional deviations of a marked degree. In 1942 a clergyman came into the hospital with what seemed like an obvious arteriosclerotic psychosis. He had a history of two recent severe attacks of coronary thrombosis, well confirmed by the internists, and supported by electrocardiographic evidence of previous coronary disease and myocardial damage. This man caused a lot of trouble by exhibitionism and attempts to rape any female that came within his range. Insulin therapy did not help fast enough to satisfy the family so they insisted on electric shock treatments. He took them well and made an occupational type of recovery. We gradually learned that in the case of most heart conditions, the patients were in greater danger from the beating the heart was taking from psychotic behavior than they were from electric shock.

We use the standard treatment of change of environment, good general care, good food, vitamins, a congenial atmosphere and occupational therapy. Regular insulin is the only type used. Curare before electric shock is a regular procedure. If possible, the patient should have a thorough physical, neurologic and laboratory study. Psychologic observations and testing are used when possible. The director of insulin or electric shock therapy must be experienced. As soon as there is enough return of insight, psychotherapy conferences are desirable. A survey of the home environment is needed and sometimes some of the relatives also need psychotherapy. It does no good to obtain a satisfactory recovery in

the hospital and then return the patient to an unsympathetic, ununderstanding and disturbing environment. The patient may be well enough to stand up under it, but a bad environment contributes to relapses.

We have summarized the records of 20 patients to illustrate some of the points we have been trying to make. In all of these patients before we saw them, the diagnosis was senile psychosis.

GROUP I

Case 1. An 80-year-old housekeeper was seen in 1942 because of a senile psychosis. She had not been well for at least two years because of rheumatoid arthritis, chronic otitis media with tinnitus, decreased hearing and spells of vertigo, chronic dermatitis, and progressive fears for her relatives involved in the war. In 1940 she began to slow down, was less alert, lost pep and interest and her memory decreased for recent events. She was withdrawn, inactive, weak and awkward. She had numb feet, was depressed, had poor insight and judgment, sat or lay around all the time, and resisted food and fluids. She wanted to die, and thought people were doing things to make her unhappy and that she had done something wrong. She became untidy and lost weight. Hospital care was refused and all home care was resisted by the patient. She successfully resisted all attempts to remove her from the home. In 1942 a program of improved general care, a better diet, more fluids, vitamin therapy, continuous attention, medical support and conferences (twice weekly) was begun and was continued for two years. By 1944 she seemed quite normal, fired the help and resumed her housekeeping and yard-garden activity. She has continued to be well, except for two light attacks of coronary thrombosis and a severe attack of pneumonitis. As soon as she is up and about after each illness, she fires the help and resumes the housekeeping.

Case 2. A white corporation executive was retired in 1932 at age 70, and started a real estate business. He talked too much and wrote too much. He gradually became untidy and careless of his personal appearance. His insight and judgment decreased. He argued over minor things and lost some money and many friends. He was seen in 1944 at age 82 because he thought little worms were crawling from his scalp. He went from one doctor to another to get support of his termite idea. The diagnosis of senile psychosis was made by all of the physicians who saw him. He began making foolish business mistakes. In order to prevent him from losing money, the relatives wanted some control. The psychiatrist advised preparation for permanent care. The patient resented any interference or control. He resented any one who took an active interest in his protection. He was sure there was a plot to harm him. He knew things were being stolen from him and his home. In 1946 he was placed in a private home away from his relatives. Good general care, good food, vitamin therapy, a congenial atmosphere and occupational therapy were provided. By 1947 he was back to his pre-1943 mental ability and was able to resume his real estate activities in the new environment. He is still active in 1952, at age 90.

GROUP II

Case 3. A 70-year-old clergyman was in the hospital from June 18 to August 9, 1946. He was retired, except for after dinner speeches and lectures. In 1938 he was ill with an anxiety neurosis. He was nervous, weak, inefficient and asocial. He was told he had a myocarditis. In 1944 he left an important position to run for the U. S. Senate. He lost the election and also lost his pension by two years, as he was unable to regain his former position. He had insomnia, floating sensations, inertia and depression for several months. Then he had periods of agitation, was disoriented, mute, uncooperative, resistive and confused. His food and fluid intake were poor and he had a low grade fever. The physical and neurologic findings were otherwise normal and the results of laboratory tests were normal, including the electrocardiograph. He was given 12 electric shock treatments and improved. His wife

took him from the hospital and refused follow-up therapy. He was back in the hospital from August 24 to September 21, 1946 because of a relapse. He received 7 more electric shock treatments and reached a satisfactory grade of amnesia. The forgetfulness disappeared in two weeks and he was soon able to return to his previous work. Psychotherapy was used for a short time, but the patient interrupted it.

Case 4. A 62-year-old business man was in the hospital from July 21 to September 25, 1951. He had observed a neighbor's illness and death in March 1951. His previous variable and indefinite stomach complaints now became a source of considerable concern. He worried about himself, had frequent nausea and vomiting with ideas of ulcer, a bad heart or cancer. He did have hemorrhoids. He feared he would die if his bowels did not move. He was inert, inefficient, pepless, depressed and had anorexia and insomnia. He became mute and at times went into a catatonic stupor. The physical, neurologic and laboratory findings were normal. He received 7 electric shock treatments and insulin (peak load, 25 units), from July 25 to August 23, 1951. He made an excellent recovery and has returned to his regular work.

Case 5. A 60-year-old farmer was in the hospital from December 11, 1946 to February 1, 1947. His wife had been very ill with a severe, almost fatal, agitated depression earlier in 1946 following an unproven diagnosis of syphilis. Although she made a complete recovery, she was younger than he and his thoughts of infidelity could not be eliminated. He became restless, nervous, depressed and his sleep was poor. He kept a constant observation of his wife's activity and associates. Although he became depressed and inefficient in his work, he was more talkative. He thought he might have a venereal disease. He was out of touch with reality, his insight and judgment were gone, but at times he seemed alert. He was very suggestible and began to fabricate. He was dirty and incontinent. His physical, neurologic and laboratory findings were normal. He was given 12 electric shock treatments and insulin (peak dose, 20 units) from December 15, 1946 to January 29, 1947. He soon returned to active farm duty but the wife seemed too happy and socially inclined to suit him. His previous nervous and mental symptoms returned early in October 1948. He then had delusions of unfitness and guilt, and ideas of suicide. The result of the routine check-up being normal, he was given 12 electric shock treatments and insulin (peak load, 50 units) from December 15, 1948 to February 26, 1949. He soon returned to his active farm work, hurriedly dismissed the need of interval conferences, and the previous suspicions and fears returned. He had a relapse in the fall of 1950. He has successfully resisted any further treatment and now has become a helpless invalid.

Case 6. A white farmer of 64 years was hospitalized from February 17 to April 28, 1945. He sold his farm in 1944 and then did odd jobs around town. He was unhappy, restless, talkative and got around a lot. He had insomnia and his folks thought he had a memory defect. He was elected to a county office in the fall of 1944 and took the oath of that office. He worried about the oath and, although he never was religious before, his conversation became religious and he was guided by God. On February 3, 1945, a dog bit him on the right forearm. The patient became more restless and talkative. He recalled some evil things he had done and became depressed and tearful. He had lost his wife's money. Cigarettes, newspapers, the radio and food were doped; the bed was wired for people to hurt him or hear what he said; the police were watching him; he had not slept for two weeks. He was underweight, and had a cellulitis of the right forearm with a white blood count of 15,000. He had hallucinations, was restless, deluded, talkative, combative, resistive, destructive and noisy. He blocked the door shut. At times he was incoherent and confused and at times he was semicomatose. He was given 10 electric shock treatments and insulin therapy (peak load, 50 units) from February 19 to April 21, 1945. He soon became well adjusted at home and, since he was unhappy when unoccupied, started and ran a small real estate business until December 31, 1949, at which time he returned to the hospital. His wife had died suddenly and unexpectedly from a heart attack. Immediately there was a rapid return of the previous syndrome in its acute and severe stage. This time he had a secondary anemia and the electrocardiogram showed evidence of myocardial damage. He received 23 electric shock treatments and was given insulin (peak dose, 50 units) from January 2 to May 5, 1950. The

Minnesota multiphasic personality inventory gave normal readings on April 21, 1950. He left the hospital on May 14, 1950 and was soon able to return to his occupation.

Case 7. A 76-year-old farmer was in the hospital from April 14 to September 3, 1949 because of an acute confusional state following a hernia repair in March 1949. Prior to the surgery he had slowed down and was weak and depressed. His energy was poor and he had trouble planning work and getting it started or finished. Following surgery he was talkative and, when he was not incoherent and confused, had delusions of unfitness. He was disoriented and would wail and talk. He insisted he had to work and yet could hardly get out of bed. He had visual and aural hallucinations and delusions of persecution. He fought nursing attention and was dirty and incontinent. His blood level of NPN was 48 mg. and of creatinine, 2.3 mg. per 100 cc. A PSP test showed a dye excretion of 29 per cent. He received 10 electric shock treatments from May 17 to June 23, 1949 and insulin (peak dose, 12 units) from April 17 to August 27, 1949. He has made a good recovery and is now doing light farm work.

Case 8. A 64-year-old farmer was in the hospital from January 5 to February 27, 1952. He had not worked well for a year. He was nervous, inefficient and either sat around or was restless. For six months he was depressed but continued to do light work. On December 27, 1951 he had a hernia repaired and by January 2, 1952 he was restless, talkative, disoriented and confused. He was fearful and had delusions of unfitness and of persecution. He thought his room was wired. He had hallucinations and he talked all the time, frequently answering his hallucinations. His thought content was highly religious. He stated that his left arm didn't work right, and that he was going to have a baby. He became agitated, resistive and combative. At times he was a minister and gave rambling, confused sermons. There was repetition of words and sentences; he would fabricate and was hyperactive and euphoric. He had a low grade fever, nausea and vomiting. He was dirty, incontinent, and couldn't feed or take care of himself. He tore his clothing and was destructive. At times he would go into a semistupor from exhaustion. Except for the surgical wound he was physically normal. The neurologic examination showed nothing abnormal. The laboratory test results were normal, except for a low red blood cell count (secondary anemia) and blood NPN levels of 60 mg., 55 mg. and 26 mg. per 100 cc. on interval testing. He was given 6 electric shock treatments and insulin (peak load, 30 units) from January 5 to January 28, 1952. He is now back doing regular heavy farm work and thinks further conferences are unnecessary.

Case 9. A 60-year-old attorney was in the hospital from May 1 to July 12, 1951 because of confusion and depression. A coarse tremor of several years' standing began to interfere with his work in February 1951. For a year he had been nervous, irritable, inert or restless, depressed and crying. He couldn't make decisions and he couldn't sleep. He was confused, excitable, had delusions of unfitness, and was sure he had syphilis. He had a monotonous speech and a mask, was slowed down, stooped, disoriented and confused. He showed delusions, hallucinations, awkwardness, diplopia, and day sleep with night wakefulness and prowling. The laboratory findings were normal. The Wechsler-Bellevue scale showed an IQ of 105 and a Minnesota multiphasic score of D80 on May 4, 1951. He was given insulin from May 5 to July 7, 1951 (peak load, 20 units). He left the hospital on July 12, 1951 against advice. He soon relapsed and couldn't be handled at home or in a local hospital. He was rehospitalized from December 12, 1951 to January 31, 1952. The situation was the same or worse than before. He now had rheumatoid arthritis, blindness, dysphagia and days of hypersomnia. He was given 100 mg. of pregnenolone intramuscularly daily. He received insulin from December 14, 1951 to January 29, 1952 (peak load, 30 units). He has steadily improved and since April 1952 he has been capable of half-time light to moderate work.

COMBINATION OF GROUPS II AND III

Case 10. A 78-year-old farmer was in the hospital from December 4, 1946 to January 20, 1947 because of confusion and depression. He had had stomach trouble for fifteen years. He complained of gas, bloating, and constipation, for which he had had a hemorrhoidectomy at age 70 and an appendectomy at age 76. In the previous year he had complained

more of his stomach and had anorexia and insomnia. He became forgetful, got his work mixed up or forgot to do it, was depressed and cried easily. He was given to fabrication, talked nonsense, was too talkative and at every chance engaged in arguments which always upset him, his wife and his son-in-law. He liked to paint but couldn't do a good job. He became asocial and mute at times. He was undernourished, unkempt, incontinent, fearful, had delusions of persecution, and was mildly resistive. He received insulin from December 12, 1946 to January 4, 1947 (peak load, 15 units) and made a good recovery. He returned home and was able to adjust well with the home folks and do good work until he was caught in waist-deep water in the flood of 1951 and used contaminated food and water. He was hospitalized from September 1 to November 6, 1951 because of an acute gastroenteritis and acute pyelonephritis with an associated return of his previous abnormal nervous and mental behavior. He was treated with antibiotics and insulin. Insulin was given from September 1 to November 6, 1951 (peak load, 15 units). He made a good recovery and adjusted well with strangers but he could not get along with his relatives. For this reason he was placed in a rest home, is making favorable progress and doing light work.

Case 11. A 66-year-old oil operator was observed in the hospital from February 6 to March 9, 1949. He had not been well since November 1948, when he became euphoric, restless, over-talkative, had a memory defect, made stupid mistakes and lost money foolishly. His insight and judgment were poor. He began aimless prowling at night. On the night of February 5, 1949 he was brought into the emergency room three times because of complaints by others about his prowling. He would get into the wrong apartment or house and the police were called. He was disoriented, suspicious, aphasic, confused, weak, cyanosed and fearful. He escaped from the emergency room twice and then was returned to the hospital unconscious. He was cyanosed and his respirations were shallow and rapid. His pulse rate was 140 and irregular, with many extrasystoles. The blood pressure was 170/100. He was febrile for a week. The breath sounds were harsh, there were many dry rales and there were crepitant rales at the bases. He needed continuous oxygen for twenty-four hours, then irregularly for a week. The spinal fluid was normal. The electrocardiogram showed evidence of myocardial damage. The blood NPN level was 40 mg. per 100 cc. and the PSP test showed a dye excretion of 25 per cent. Antibiotics were given for two weeks and insulin from February 6 to March 8, 1949 (20 units, peak load). In June 1949 he was able to engage actively in his business.

Case 12. A 71-year-old business man was in the hospital from May 1 to June 19, 1950. He had periods when he was either inert and uncommunicative or restless, talkative and confused. He was unkempt and incontinent. For several months he had been moody. The high cost of his mistakes resulted in pseudo-retirement, as all of his transactions had to be checked. His insight, memory and judgment obviously were faulty. At times he was inert and depressed but he too frequently was elated, talkative, noisy, and figuring out big deals. When he was depressed, he was unkempt and dirty, and when he was elated he talked of much money and expansive plans. He became suspicious of his wife and men. He became constantly unkempt, incontinent and unable to feed or dress himself. He had arthritis, a blood pressure of 160/85 and bilateral inguinal hernias. The findings on neurologic examination were normal. Interval blood NPN levels were 42, 30 and 29 mg. per 100 cc. and PSP tests showed dye excretions of 34, 54 and 64 per cent. Insulin therapy was used from March 3 to June 18, 1950 (peak load, 30 units). He was able to return to normal home life and light to moderate business activity. He got along very well until early May 1951, when his trusses became inadequate. Because of irreducible hernias he was in the hospital from May 8 to May 20, 1951. The surgeon considered him a poor risk and sent him home. He had extra systoles, and a blood pressure of 118/50. The PSP test showed a dye excretion of 16 per cent. The mental state was quite good. He resumed his previous activity, which was reasonably normal, but this resulted in incarcerated hernias. He had one hernia repaired on June 21, 1951 and the other on July 9, 1951. Insulin therapy preceded and followed each operation. Each operation resulted in a temporary return of the former psychosis. Each operation was followed by additional cardiac findings, ending up with auricular fibrillation and left

ventricular strain. He was given insulin from June 23 to September 12, 1951 (peak load, 40 units). He has made a social type of recovery and has resumed some contact with his business.

Case 13. A 68-year-old farmer was in the hospital from January 15 to February 27, 1952. He had no special complaints and only wanted to be checked up. He felt well and just didn't understand his family. Bladder trouble had started in 1949, and he had been no good for work since then. He was not dependable and his judgment was poor. He was always alert but didn't seem to understand. He talked a lot, argued, and seemed to recognize his mistakes but could not correct them. He was cheerful and agreeable but always continued his previous conduct, contrary to promises. It became obvious that his insight and judgment were poor. Progressive urinary difficulty resulted in a prostatectomy in October 1951. All of his faults increased. He more readily agreed to anything and did the opposite. He slept by day and prowled at night, so the community was disturbed. His heightened sex interest threatened all age groups, though his wife, who had frequently endured intercourse several times a day, was still the primary target. He became irritable and depressed about sex denial; nothing else seemed to worry him. Relatives recalled a lapse of memory for a week, a year previously. The physical, neurologic and laboratory findings were normal. He was given insulin therapy from January 17 to February 25, 1952 (peak dose, 12 units). At the time of his dismissal he had made a social recovery. Follow-up psychotherapy was used. In April 1952 he was able to engage in light farm work. His adjustment to his environment was satisfactory.

GROUP III

Case 14. An 82-year-old apartment manager was in the hospital from January 5 to February 18, 1944. He had a nervous breakdown in October 1942 and had never felt well since. He was flighty, agitated, irritable and restless, with spells of vertigo and urinary frequency. He was absent-minded but refused to acknowledge his mistakes and blamed others for his money losses. He was moody and his judgment and insight were poor. He quarreled with patrons, threatened them, was easily angered, and had delusions of guilt and of persecution. The physical, laboratory and neurologic findings were normal. He received 10 electric shock treatments and was given insulin (peak load, 50 units) from January 6 to January 31, 1944. He made a complete recovery and has continued to be active at his old job.

Case 15. A 69-year-old white grounds-keeper was hospitalized from March 31 to June 7, 1945. Since 1943 he had had variable pain in the abdomen and chest, with feelings of internal pressure, tension and tremor. He was sure he had a cancer. His appetite, sleep and memory decreased; he lost weight, gradually slowed down physically, and was less alert, although at times he was restless and anxious. He became untidy and soiled his clothing. He feared death, had ideas of guilt and of plots to kill him, talked of suicide, refused food and had no insight or judgment. He had been unable to work for six months. The physical and laboratory findings were normal. He was given 6 electric shock treatments and received insulin therapy (peak daily dose was 15 units) from April 4 to June 2, 1945. He made a complete recovery, soon returned to work and still maintains his health and activity.

Case 16. A 60-year-old housekeeper was in the hospital from May 15 to May 23, 1948. She had been losing energy and interest for one year. She was depressed, tearful, irritable, and paranoid at times. She had severe headaches, her memory was poor, and she became disoriented and confused. She had high blood pressure for twenty years and had a left hemiplegia in 1939. She quit work in November 1947 because of her mental condition, which was worse following influenza in February 1948. On admission she was confused, deluded, unkempt, disoriented and incontinent. Her blood pressure was 224/130. The neurologic findings were negative. The laboratory findings were normal except for a PSP excretion of 35 per cent and a blood NPN level of 37 mg. per 100 cc. The electrocardiogram was normal. She received insulin from May 16 to May 23, 1948 (peak load, 20 units) and also 4 electric shock treatments. At present she gets along well at home most of the time and can work quite well but needs an occasional electric shock treatment to maintain her stability.

Case 17. A 65-year-old farmer was in the hospital from February 4 to April 29, 1950. He was markedly withdrawn and at times seemed unconscious. He could not urinate and the bladder reached to the level of his navel. He had been nervous for more than a year, was restless, asocial and seemed to worry about the farm, world affairs and communism. He neglected his work, sat around more and more, seemed weak, disoriented and his judgment was poor. He never was talkative and at times was mute. He was brought in because of the weakness, semi-stupor and an overflowing bladder. His bladder was distended and his clothes were wet. He seemed unable to swallow. The blood NPN level was 45 mg. per 100 cc. and the PSP excretion was 48 per cent. The prostate was normal. The cystoscopic examination showed an atonic bladder. He was given 17 electric shock treatments and insulin (peak load, 30 units) from February 24 to April 26, 1950. He made a complete recovery and returned to regular farm work.

Case 18. A 72-year-old housekeeper was in the hospital from August 14 to December 28, 1950 because of her threatening attitude. She had had neighbor trouble about minor things for years. She fussed with almost every one. Her memory and judgment were poor. She was unhappy, cried, complained of pressure headaches and at times seemed depressed. Her blood pressure had been high for years. She had delusions of persecution and would peep past the curtain by day or night. She thought that people were taking things and she made open accusations; there was an active plot to bury her alive so she threatened some of the neighbors. She became unkempt and demanding, and at times she was ataxic. She refused food because she thought it was poisoned. X-ray examination of the chest showed an enlarged left ventricle and sclerosis of the aorta. The sedimentation rate was increased. All of the other laboratory findings were normal, including the electrocardiogram. She was given insulin from August 22 to December 27, 1950 (peak load, 35 units) and made a satisfactory recovery. A Wechsler-Bellevue examination made on September 19, 1950 showed an IQ of 88 and deterioration of 7 per cent. Psychotherapy at indicated intervals has resulted in adequate neighborhood adjustment and complete return to her previous housekeeping duties.

Case 19. A 63-year-old farmer was in the hospital from September 8, 1950 to May 20, 1951. He had been ill for eighteen months and had not worked for a year. His energy and interest had decreased. At times he was withdrawn and at times talkative and sociable. He was moody, would sit in the chair, and towards evening would get cranky and cross and then depressed. He began to use some alcohol and then had delusions involving several relatives and their sexual habits. He threatened both suicide and homicide. His appetite was good and his weight increased. He jumped through a window without opening it. He had insomnia, was out of touch with his environment, often made passes at women to the point of occasional ineffectual physical efforts, was sexy in his thought content, and was unkempt and incontinent. He stated that he knew of a definite plot to rape his wife and that he had killed one man and wouldn't hesitate to do it again. Physically and neurologically he seemed normal. The laboratory findings were normal except for electrocardiographic evidence of left bundle branch block. He received 29 electric shock treatments from September 14 to November 8, 1950 and insulin (90 units, peak load) from September 11, 1950 to May 19, 1951. The Wechsler-Bellevue test on December 1, 1950 showed an IQ of 92. The Minnesota multiphasic test on December 1, 1950 showed F (validating) 110; Pa (paranoid) 92; Pt (psychasthenia) 72; Sc (schizophrenia) 115 and Ma (manic) 88. Further findings were: on January 5, 1951, F 110, Pa 100, Pt 75, Sc 102 and Ma 93; on January 20, 1951, F 98, D (depression) 82; Pa 74, Pt 79, Sc 88 and Ma 80; on February 2, 1951, F 73, Pa 76 and Sc 73. He has been at home since May 20, 1951 and has progressively adjusted himself to the environment and is gradually increasing his farm activity.

Case 20. A retired 68-year-old business man was in the hospital from January 5, to February 27, 1950. Three years of inactivity had bored him. He became nervous, irritable, depressed and tearful. He was cross, quarreled with his wife, and at times was mean to her. He had excessive sexual desires without being able to complete the act. He blamed a 1940 hernia operation for damaging him sexually. He had lapses of memory and at times would

be badly burned from sitting in the sun. Once after too much sun exposure the relatives thought he had a light stroke. Unable to have satisfactory intercourse, he accused his wife of uncooperation, of masturbation and of consorting with other men. There was a marked tendency for him to have delusions of persecution and to become antagonistic and combative without provocation. His physical, neurologic and laboratory findings were normal. He received insulin from January 17 to February 26, 1950 (peak load, 7 units) and was able to make a satisfactory adjustment at home, except that he could not forget that before his hospital stay his wife had had him examined and psychoanalyzed for a senile psychosis. To clear up this thought, which he couldn't get rid of, he returned to the hospital on July 6, 1950. On his previous admission his pre-treatment Wechsler-Bellevue showed an IQ of 120, a normal result with the Minnesota multiphasic test, and a Rorschach test opinion of monomania of a sexual nature. The result of the Rorschach test was normal at the time of the February 27, 1950 discharge. To ease his mind, he stayed in the hospital from July 6 to September 5, 1950. He behaved and talked normally. He asked for another series of insulin treatments, which was given to him from July 11 to September 4, 1950 (peak load, 12 units). The Rorschach test still showed a completely normal pattern. On September 5, 1950 he left the hospital, to follow self-employment at light to moderate activity levels. He has continued to show normal social and occupational adjustment and activity.

SUMMARY

Brief outlines are given of experiences with 20 geriatric patients, ill with severe mental disorders. In all, the diagnosis had been senile psychosis and a poor prognosis had been given before we saw them. The age range was from 60 to 82 years and the average age was 69 years at the time treatment was started. Two of the patients (Group I) responded to therapeutic procedures that usually fail. Eighteen of the patients were given insulin and/or electric shock treatments. They were given from 4 to 29 electric shock treatments, with an average of 12 treatments. One patient had electric shock therapy without insulin and 7 patients had insulin therapy without electric shock. Eleven received a combination of insulin and electric shock therapy. The insulin peak dose ranged from 7 to 90 units and averaged 30 units. Fifteen of the patients made an occupational grade of recovery and 4 made a social grade. One patient made an occupational recovery and relapsed; with further treatment he made an occupational recovery and relapsed; more treatment was refused. Six patients relapsed but, with re-treatment, regained their previous grade of recovery. The 18 patients in Groups II and III were elderly and sick. This combination frequently ended in death in the days before insulin was used in mental disorders. We think the addition of insulin and electric shock therapy has greatly improved the prognosis of some geriatric patients with mental disorders.

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BOOK REVIEWS

YEARS DO NOT COUNT. BECOME OLD WITHOUT AGING. (JAHRE ZÄHLEN NICHT. ÄLTER ZU WERDEN, OHNE ZU ALTERN)

H. Graupner.

Heidelberg, Keyser'sche Verlagsbuchhandlung. Book 408 pp. 8°. 1951.

At this time, when in many countries work associations and institutions are founded devoted to the problem of aging, several outstanding books treating the above subject have been published in Germany. This work certainly is one of them. It contains a large amount of practical advice for everyday life.

An attempt is made also to explain the physical and psychic problems of aging. The statement is made that every human being is aging right from the very beginning of his life. Reference is made to the Latin quotation: "Nascentes morimur."

The years of crisis are discussed, during which a great many phenomena of aging occur, continuing after the critical years.

All such problems should not be treated from a scientific standpoint only. They should be explained in a matter-of-fact and pertinent manner intelligible to everybody. In this way the knowledge of these most important facts is brought to the attention of the layman as well.

R.P.E.H.

AGING AND THE ATTEMPT AT REJUVENATION. (STARZENIE SIE PRÓBY ODMLADZANIA)

W. Maskwa.

Lódz 1, Poland, Wydawnictwo "Kolumna". Book 70 pp. 8°. (Year not stated, but recent publication.)

This book is considered a manual and contains a compilation of almost the entire world literature on gerontology. Six chapters are devoted to the history of all types of medical endeavors to combat aging. Then follow statistics regarding life's duration and a discussion of internal and external factors which limit the above. Reference is made to various theories on aging, and different rejuvenating methods are discussed and criticized.

In the last chapter a report is made of prophylactic methods, such as recommended by Bohomolec. It is advisable to keep all organs working, to a reasonable and moderate extent. Expedient respiration and suitable nutrition, as well as daily walks and gymnastics are considered most important.

Scientists and people leading a sedentary life are warned not to forget to take care of their blood circulation and their musculature. If they neglect it, it will lead to conditions just as deplorable as those seen in people devoting all their time to physical work only. Sedentary workers may neglect their health as well and lose all interest in science and art. Harmonic development of the entire organism, all kinds of exercise, and maintenance of the harmony—that is the way leading to longevity.

R.P.E.H.

Current Geriatric Literature

HEALTH STANDARDS OF HOUSING FOR THE AGING POPULATION.
R. J. Johnson and M. A. Pond.
J. Gerontol. **7:** 254, 1952.

Basic principles of healthful housing have special significance for older persons. The latter require considerable space for storage of their possessions, which are an important part of their life. Housing can also be a positive factor in health and happiness of the aged. The value of living the remaining years in familiar neighborhoods cannot be estimated too highly. The wants, and the physiologic and psychologic needs of old people are decidedly different from those of younger persons.

An attitude considerate of differences existing between the aged and the younger generation should also foster improvement in housing. Recognition of basic economic, political and social factors pertinent to aging should be considered.

There should be added the motivation to accomplish such tasks in responsible parties, challenging their ability and ingenuity. An enormous amount of research and investigation is still necessary, before the goal will be reached. Systematic application by federal, state and municipal authorities, as well as by the building industry is required. The now existing knowledge of the health needs in housing for the aged population should also be taken into careful consideration.

AGING OF THE RETINA OF MAN. (DAS ALTERN DER NETZHAUT DES MENSCHEN).
A. Pillat
Wein. klin. Wchnschr. **64:** 856, 1952.

So far, not very much has been published regarding senile ocular changes other than those in the lens and the sclera. The latter include presbyopia and senile cataracts. The present article does not go into details about senile diseases of the eye, but treats of senile ocular changes in the retina. Especially concerned is the retinal pigmented epithelium which, at about the age of 60, shows increase of the fundus tabulatus. At this age, decrease of the pigmented content of the retinal epithelium and degeneration of the cells are found. Progressive aging of the retinal parenchyma is indicated by the decrease of transparency of the tissue, through the increase of Blessig-Iwanoff's cavities, and the formation of cysts in the macula. It is also demonstrated by changes in the membrana limitans interna, the loss of brilliancy of the inner retinal surface and the disappearance of reflexes in the foveate area. All these changes are distinctly visible through photography. The aging macula has an orange-yellow tint, versus a lemon-yellow tint in the young. Indistinctness and lack of homogeneity of the macular yellow and the aging of rods and cones, are other signs. Decrease of vision, of light sense and of the field of vision are also signs of the senium. Aside from the development of certain changes of the retinal vessels through old age, senile fatty degeneration of the retinal parenchyma is found rather frequently, as well as concrement formation of senile pigmentation. All such conditions show in the corresponding pictures of the fundus oculi.

Frequent senile ocular diseases are degeneration of the macula (Haab), disc-like degeneration of the retinal center (Oeller), senile macular cavity and others.

TRAINING THE OVER-AGE EMPLOYEE FOR RETIREMENT.
P. N. Scheid.
J.A.M.A. **147:** 1323 (Dec. 1) 1951.

It is difficult to determine just which organizational division is responsible for concentrating the attention of management on the problem of preparing the over-age employee for retirement.

Adequate appreciation of the problem and research involve several factors. These are employee relations, subsequent medical responsibilities, training programs, and a multitude of complications not yet anticipated.

The medical profession has been responsible for increasing the individual life span. The advice and counsel of its members are urgently needed by executive management. Thus might be determined means and ways of adjusting the individual to the new life that confronts him.

In the last years great strides have been made in the development of techniques and methods for the education of adults. However, it would appear that a new set of principles may be necessary, before one can effectively educate the over-age adult to cope with problems of his specific concern.

Considerable cooperation, work and research, contributed jointly by the medical and educational professions, will be necessary. In this manner an adequate solution to the problem of training the over-age employee for retirement may finally be reached.

A CLINICAL APPROACH TO SENILE OSTEOPOROSIS.

R. H. Schoene.

Ohio State M. J. **48:** 126, 1952.

Thirty patients with the syndrome of senile osteoporosis of the spine were treated with testosterone propionate. Pain was the presenting symptom in all cases; relief from pain was uniform and sustained. Thus the aging bone has been given a new lease on life by the use of anabolic steroids.

In the many cases of postmenopausal osteoporosis the author was impressed by the fertile field of usefulness of estrogens and androgens. Even a 90-year-old female looked 20 years younger after treatment. Euphoria was usually noted.

Through anabolic steroids, improvement of bone healing in fractures suffered by elderly people was observed.

Caution must be exercised in making a correct diagnosis and in the use of this potent steroid. Occasionally cases were observed which showed retention phenomena. However, cases with complicating hypertension and arteriosclerosis when carefully observed, showed no intolerance to this therapy.

SO-CALLED CHRONIC EMPHYSEMATOUS BRONCHITIS. (ÜBER DIE SOGENANNTE CHRONISCHE EMPHYSEMBRONCHITIS).

B. Steinmann and M. Schmid.

Schweiz. med. Wchnschr. **83:** 103, 1953.

Emphysematous bronchitis in old age is an ailment of frequent occurrence, the therapy of which is most difficult. In fact, the chronic nature and the complicated treatment of this disease make it a social problem. In 26 patients aged 63 to 80, emphysematous bronchitis was diagnosed by means of bronchography. Eleven of the 26 patients, whose average age was 72, died. Because of the high percentage of mortality, the severe aspect of this disease is discussed. For exact determination of the clinical picture, thorough investigation based upon certain affections having occurred in the patient's earlier life, is required. These affections, in particular, are bronchial, pleuritic and pulmonary diseases, chronic bronchitis, bronchiectasis, vesicular emphysema, allergic asthmatic components, or chronic cor pulmonale. Special attention is called to the very frequent occurrence of bronchiectasis which, in old people, is mostly acquired after the patient has become senile. In 19 cases out of 26, bacteriologic differentiation of the sputum was made, revealing very often the presence of Streptococcus viridans and, next in frequency, Bacillus coli. Most patients admitted to the hospital for chronic emphysematous bronchitis had been complaining of symptoms of bronchopneumonia, asthmatic dyspnea or cardiac trouble. The principal causes of death in such cases were cardiac insufficiency or bronchopneumonia. In certain fatal cases amyloidosis resulting from chronic suppurative processes was found in senile individuals.

Emphysema in old age is a physiologic phenomenon, due to loss of elasticity of the lungs and enlargement of the pulmonary alveoli. It may develop also through senile involution of the tissue, disappearance of interalveolar septa to the confluence of the alveoli, and decrease of the respiratory surface. According to recent findings, this disease in the aged is a substantial emphysema, in which atrophy of the elastic tissue, of the smooth musculature and of the capillaries plays an important role.

THE RISK OF UROLOGIC SURGERY IN MEN PAST 80.
G. J. Thompson.
J. Gerontol. **7:** 223, 1952.

Old men with disease of the urinary tract are better risks for surgical procedures than is commonly appreciated.

Severe illness and death can often be avoided through operation, in preference to temporizing measures. The latter in themselves often involve a high risk.

Careful preoperative examination and preparation for surgery is essential. Through preliminary appropriate nursing and medical attention, the condition of the patient will usually improve sufficiently to justify operation. This applies even to cases of apparently almost desperate illness. Collaboration of internist and urologist is highly desirable.

Cautious use of preoperative sedatives and opiates and selection of the proper anesthetic agent are essential. The duration of the operation should be short; shock is to be avoided. Alert postoperative management is necessary, in order to avoid complications. Replacement of blood loss and prompt use of antibiotics, when indicated, are of paramount importance.

The mortality rate in this series of 654 patients (all beyond 80) was 4.1 per cent.

PHYSIOLOGIC ELECTROCARDIOGRAPHIC CHANGES IN THE COURSE OF AGING, ESPECIALLY IN OLD AGE. (DIE PHYSIOLOGISCHEN EKG.-VERÄNDERUNGEN IM LAIFE DES ALTERS MIT BESONDERER BERÜCKSICHTIGUNG DES HÖHEREN ALTERS).
R. Wenger.
Wein. klin. Wchnschr. **64:** 999, 1952.

Electrocardiographic examinations at different ages show that the limits of normal are by no means similar. During advancing age certain electrocardiographic changes are considered normal which, in middle age, are looked upon as pathologic. This is also the case in infancy, when frequently negative T-deflections are observed up to V_4 towards the left. In older people, increasing deflections to the left form the anatomic basis. This is produced by increase of blood pressure followed by left hypertrophy, in addition to a more pronounced transverse position of the heart. In cases of frequent occurrence of changes in the T-deflection, presence of coronary sclerosis must be taken for granted. At an Austrian medical university clinic 200 patients with more or less normal hearts, aged 60 and over, were examined. In the majority, flat to isoelectric T-ventricular complexes in I-deflections were ascertained. With advancing age this condition was found to be gradually increasing.

Instead of using the term "myocardism" in electrocardiograms of this type, the designation of "myocardial changes" is suggested. Exhaustive use of all possibilities for electrocardiographic diagnosis is possible, only if the amnesis, as well as all clinical and roentgenologic findings, are taken into consideration.

GERIATRIC DERMATOSES; A SURVEY OF THE SKIN OF THE AGED.
S. J. Zakon and A. L. Goldberg.
Illinois M. J. **101:** 37, 1952.

Ninety-eight males and 124 females, aged 60 to 91 years, were treated for dermatoses. Senile pruritus was a most distressing symptom and very difficult to relieve. The underlying cause was probably arteriosclerosis.

The most frequent symptoms were:

Senile angioma (found in 71.4 per cent of males and 87.9 per cent of females).

Nevus pigmentosus (found in 41.8 per cent of males and in 53.2 per cent of females).

Comedos (found in 44.8 per cent of males and in 28.1 per cent of females).

Lentigo (found in 35.2 per cent of males and in 54 per cent of females).

Seborrheic verruca (found in 29.3 per cent of males and 37.9 per cent of females).

Tinea pedis (found in 22.4 per cent of males and 33.8 per cent of females).

Tinea pedis is of diagnostic and therapeutic importance. The toes of the aged require gentle care, since any inflammatory process may predispose the tissues to gangrene. Hence strong topical remedies or roentgen-ray therapy to the toes should be used with great caution. The treatment should mostly consist of bathing the feet daily in 1:10,000 solution of potassium permanganate.

The paucity of malignant cutaneous neoplasms can be explained on the basis that very few of the patients under observation had ever been exposed to the carcinogenic factors of sun rays. Practically all their lives these patients had avoided the physical factors of outdoor life.